Vol. XXVII., No. 4. Dec., 1901. Whole No. 100.

# PROCEEDINGS

OF THE

UNITED STATES

# NAVAL INSTITUTE.

VOLUME XXVII.

EDITED BY L. S. VAN DUZER.

PUBLISHED QUARTERLY BY THE INSTITUTE.

ANNAPOLIS, MD.

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The Lord Baltimore Press
THE FRIEDENWALD COMPANY
BALTIMORE, MD., U. S. A.

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# UNITED STATES NAVAL INSTITUTE.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

## THE COAST IN WARFARE.

By LIEUTENANT-COMMANDER JAMES H. SEARS, U. S. Navy.

### PART II.

*(Continued from No. 99)*

One tendency to-day in naval construction is in the direction of armor-clad vessels of extreme size and great power, and in this respect, as in others pertaining to ship construction, nations appear to follow one another. It is evident that the offensive power of a vessel is or should be the first consideration with naval architects, and when that is provided for, then it is proper to cover that power with protection. In some vessels the armor protection takes the form of a belt calculated to protect the flotation of the vessel, or in other words, the gun carriage in combination with a protective deck. In others, the guns are grouped in citadels, and the belt is only of partial extent, or entirely absent; again, turrets are used to cover the guns in combination with other protection to the vessel. Sometimes the exposed hull is entirely covered with a moderate thickness of armor. Frequently the flotability is further pro-

tected by an absorbent filling matter in compartments, subdivisions more or less numerous, and with double or treble bottoms, which still further add to the security, the vessels at best being compromises. The problem confronting the designer or architect is indeterminate. It would be simple and easy for him to design a vessel embodying in a high degree a lesser number of the qualifications imposed upon him, but the maximum offensive with the maximum defensive are somewhat antagonistic qualities, and the different ways in which the solution of the problem is worked out have produced the varying results to be observed in the heterogeneous make-up of modern fleets. The monitor type and the "New Ironsides," contemporary types, furnish one illustration of the development, at that date in either direction, of complete armor protection. To-day the monitor type and that of the Dupuy de Lome, perhaps, are at either end of the scale. The question of the relative offensive power of either type in engaging with land defenses was settled beyond all dispute in the Civil War, for when the Ironsides turned her broadside on any single work with which she was engaged before Charleston she compelled the gunners to seek shelter. Three shells in the air at one instant were incomparably more effective than the slow practice of the turrets.

In a discussion in the United States Naval Institute in 1879, two officers who were present in Charleston stated that in the various attacks of the ironclad squadron upon the earth and sandworks, that the New Ironsides with her broadside, which was composed of seven 11-inch guns and one 200-pdr. Parrott rifle, could silence Wagner or Gregg with comparative ease; whereas, when those works were engaged by several monitors, uniting an equal or greater number of equal guns, the weight of metal being in excess, the batteries were not only not silenced but briskly returned the fire of the monitors. It was further stated that often the monitors upon withdrawal would be replaced by the New Ironsides with the result of securing silence in the batteries.

The monitor type pure and simple, which needs no description, might safely contend with the horizontal fire from low-placed batteries; its passive defensive properties are a maximum, except that the muzzles and chases of the guns are liable to

serious injury from small projectiles, even to disablement; but against properly designed and dispersed fortifications the offensive powers are a minimum. It is generally recognized that the most efficient way of attacking earthworks is by a great volume of fire, which can be obtained only by the use of a large number of moderate sized rapid-fire guns.

At Alexandria, the effective work was done by projectiles reaching the embrasures of casemates or the guns themselves en barbette, and by the use of a rapid fire the chances for such hits are greatly enhanced. The addition of a rapid-fire armament to monitors without adequate protection only exposes them to destruction from the same character of fire from shore, where no limits are placed on the number or disposition of the rapid-fire guns. As they can be given mobility with almost complete invisibility, and firing from a fixed point with known ranges at large targets, no comparison seems necessary concerning the effectiveness of fire. The monitor type is quite as vulnerable to plunging fire as other types, and more exposed to it from the low freeboard characteristic of the type.

The completely armored vessel can engage fortifications only by exposing its broadside. The dispersion of the armor reduces its thickness until it is entirely exposed to rupture by smaller projectiles than would be effective against monitors. Such a vessel is also liable to many dangerous hits through the numerous ports by the rapid-fire armament. In other respects these vessels offer the most complete protection to the crew against the smaller rapid-fire guns on shore. Vessels engaging one another do so on equal terms, and it is, generally speaking, historically correct that victories were not won by sinking vessels. They were overcome or dispersed through the loss of their fighting efficiency. To-day, the vessels with the least efficiency against modern coast works are perhaps the best protected against such works, while those best fitted to cope with such works in gun efficiency are the most exposed to the loss of that efficiency.

A question of great importance intimately associated with that of coast defense generally, is that concerning so-called *coast-defense vessels*. It is possible that there exists a confusion in the popular mind as to what is meant by the term *coast-defense*

*vessel.* The term is used indifferently at times as denoting vessels of various types, and intended for widely different ends—the central idea, however, being generally well understood. If there be misconception and confusion in the one respect, it is otherwise commonly agreed that a coast-defense vessel is a vessel whose scene of operations in a maritime war is confined and restricted to the coast of the nation to which it belongs. Such a vessel is forbidden for one reason or another to take part in any of the naval operations which have for their theatre the open sea or the enemy's coast, if distant.

In the same sense that harbor defenses or fixed defenses are spoken of as coast defenses, harbor-defense vessels are occasionally referred to as coast-defense vessels. The error is not frequently made, but it is well to draw the distinction. Harbor-defense vessels are, of course, those whose actions are still more restricted, as they are assumed to find their field of action in actual participation in the defense of a particular harbor. Coast-defense vessels may be harbor-defense vessels, narrowly speaking, upon occasion, but harbor-defense vessels are intended solely to fill a gap in the other defenses provided for a particular location, or themselves to form the entire defense of the locality.

A battleship is understood to be a large ship containing within its displacement all the current approved means of offense and defense, self-sustaining at all points, capable of making any part of the world its scene of operations, of contending with any and all comers in a fair fight by itself or in combination with others of equal terms, as a unit of the fleet or squadron to which it is attached. A coast-defense vessel is one in which certain qualities may have been sacrificed to the end that others may be enhanced, in order that some undoubted superiority in one or more details may result so that it may have the advantage at the point of contact with the enemy's vessels upon and under the threat of attack upon the coast, be it in some mode of attack or in equalizing, in itself, a discrepancy in numbers. If certain qualities have been sacrificed without this corresponding material gain in power, the coast-defense vessel instead of being in her sphere something more useful than a battleship, becomes something considerably less valuable than a battleship under such circumstances. No

reference is here made to depot or station vessels, to gunboats, torpedo gunboats, rams, torpedo-boats, nor to other types which may be restricted in their use to the actual defense of the coast. While being coast-defense vessels, they are, properly speaking, coast-defense rams, coast defenders, or gunboats, etc. If, by a naval policy, sea-keeping or sea-going battleships are restricted in their radius or field of operations to the waters of the littoral, or are compelled to assume that theatre by the power or strategy of the enemy operating as a homogeneous fleet in their coast waters, it must not be assumed that they fill the idea of coast-defense vessels in the restricted sense. If the naval policy directs the dissemination of its battle force along sections of the coast or in particular harbors they would then, in the sense assumed for the term, be coast or harbor-defense vessels without the sacrifice in one direction and consequent gain in another, as before stated.

The fallacy underlying the policy which admits of the dispersion or the localizing of the naval forces, except in the possible case of vessels replacing or standing for floating fortifications, has been before exposed. The mere contemplation of the subject from the point of view of the numbers required to be superior at any possible point of contact, or to make any show of superiority, should be sufficient. This argument of course applies to an assumed case where the naval policy might be committed to such a disposal of its entire fleet. The general reasons for or against the building of special types of vessels for coast defense are presented to us at this day in a more limited sense. It is a question as to whether maritime nations of wealth and power sufficient to enable them to maintain extensive naval forces, should devote any portion of the funds voted for the maintenance of naval power to the early building of such types of vessels. Generally, when the policy of naval powers is considered by the light of their actual building policy of to-day, it may be stated that the answer to the question is in the negative. The policy of building such vessels is receiving and has received a great deal of attention. To illustrate the conflicting views, and to exhibit the wide divergence of opinions which exist, some quotations are introduced, all of which are entitled to respect, some being radical on either side of the question, while others seek a medium ground of argument.

"To build specially for C. D. is perhaps not congenial to the feeling of the country. We aim at a maritime supremacy. It is assured that in case of war we shall best defend ourselves by taking the offensive. Looking, however, to the difficulty of maintaining an effective blockade under modern conditions, it is a question whether the country would approve that it should be left at any time entirely without the protection of the fleet. Until quite recently it was an axiom that we should always have a force at hand strong enough to command the Channel. If this view were acceptable, it might be desirable to build a few vessels of a type which would be effective for coast defense though not adapted to a wide range of operations." (Lord Brassey, 1892.)

"The best coast defense is a fleet of specially constructed ironclads, capable of going to sea in any weather along a coast. Each harbor should have its flotilla of torpedo-boats. These coast-defense vessels should have a great battery power, draw little water, have good speed, and be unsinkable. They need not be strongly manned, . . . They should be accompanied by lookout vessels. The four ships of the Trehouart type seem to meet the requirements of a coast-defense service, displacement 8590 tons, two 30 cm. guns, a powerful armament, speed 17 kn. Improved monitors might be extremely effective for defensive service in the English Channel. Rams should find a place in the shipbuilding programme for the British Navy. In our large fleet no type should be omitted. We want ships of the Polyphemus type, but less complicated and less costly construction." (Admiral Penhoat.)

Captain Eardley Wilmot, after discussing at some length the question of coast-defense by vessels of an especial type and giving his views as to the most efficient defense in which he places the navy above all other means, and instances several well-known cases where the navy operating at a distance has put aside all chances of attack on the coast, says: "Tacit acquiesence in a view which apparently contemplates an enemy roaming over the seas without let or hindrance; on his appearance in force without warning on any part of our coast, seems to have led to the construction of vessels with a restricted radius of operation and incapable of service in distant waters. The desire to have within sight, as it were, a portion of the

fleet becomes at times exceedingly strong." He says again: "In thus dealing generally with the question, I by no means preclude the possibility of raids by single vessels that might escape the most complete system of blockade. At no time has it been possible to prevent such attacks by an enterprising enemy, and there is perhaps greater opportunity for them with steam than before. Under such conditions special vessels for coast-defense service have some justification, and confidence is maintained wherever the rest of the fleet is employed. The weak point of the principle is that the best coast-defense vessel is a first-class battleship, especially for an island, subjected at most periods of the year to weather that is not favorable to any but the most seaworthy craft."

In commenting on the policy of protecting fixed points by fixed forces, Admiral Colomb says: "If fragmentary local protection be a sound military principle of imperial defense, but a short step leads to localizing naval defense either by acts of parliament or, still more surely, by war vessels incapable of keeping the sea. Already there are distinct proofs of Naval Colonial defense—to say nothing of home-theories developing local proclivities. I observe so eminent authority as Sir W. Jervois recommending, for example, South Australia to expend some £150,000 a year of revenue on a three masted ironclad for purposes of local defense. She is not to be a regular seagoing ship, but is to be fit to go a certain distance equivalent to that between Lisbon and the Azores." Sir W. Jervois thus officially speaks of the duties of the Royal Navy in Australian waters: "The Imperial Squadron, small and composed of wooden vessels, being charged with visiting the islands of the South Sea, with the defense of the Fiji Islands, New Zealand, and all the Australian colonies, the chance is but small of its being available for the special defense of any one colony or any particular portion of the coast. We have here a clear illustration of the imperial programme for maintaining economically our naval supremacy. We annex Fiji, being a position of great strategic importance, a necessary point at which to store coal and naval supplies, and as soon as we have got it, it simply becomes a burden to our fleet, . . . We took the point as a means of strengthening our naval position and our arrangements are such that we must weaken our naval position to defend the

point. . . . The principle of localizing the action of a naval force, by ships that cannot keep the sea . . . to my mind contains the germs of creeping naval paralysis, which if not checked will prostrate and destroy our supremacy of the sea."

Vice-Admiral Colomb, R. N., recognized a distinction between a greater or a lesser naval power, as follows: "The error we have fallen into arises, I believe, from forgetting that the strategy of the naval power in command of the sea is necessarily diverse from that of the naval power which cannot hope to have it. France, in building coast-defense ironclads and stationing them at her great war ports, is pursuing a policy which can be supported by sound reasoning. Each of these ships is, in her place, the equivalent of a seagoing ironclad, and would compel the enemy, if he determined to blockade, to appear off the port with a seagoing ironclad for every coast-defense ironclad within it, or to suffer the chances of a reverse. But the superior navy cannot logically contemplate or prepare for any other position than that of the superior navy. If she does, every pound she spends on that assumption is so much subtracted from her own power, so much deliberately spent in encouraging inferior naval powers to hope." Should France really adopt this view there is no doubt that the periodical anxiety which England undergoes in contemplating the material growth of French naval power would be considerably eased.

Admiral Colomb with consummate ability frequently advocated a compact naval force for even the inferior naval power. His flanking fleet, though inferior, as a means of defense, is frequently insisted upon in his writings. The case of the inferior German fleet in the Jahde is one in point which he beautifully used to emphasize his position.

He says: "They (the French) dared not undertake the light business of the simple bombardment of a coast town (Colberg) because there was the neighborhood, 700 miles off, of a German inferior fleet." Assuming that the cause is rightly given, it appears that if the vessels of the compact inferior fleet had been disseminated among the various ports, the cause resulting in the saving of the coast would not have existed. When Admiral Colomb considers that the command of the sea may be called in question, that the maritime war may be brought near the shores of Great Britain, he falls back upon the fleet con-

centrated in the Downs. At such a time it would no doubt be gratifying for the English to know that the French vessels were carefully distributed around the coast. From the Downs, his fleet would seriously impede any concentration or combination against it. The weaker naval power would need the greater assistance from fortifications, and fortifications would certainly gain by the presence of floating defenses, but would the inferior gain by dividing her already weak naval forces? Would she not then have buried her last hope of restoring a resemblance of equality in case she had provided beforehand by such a naval policy for such a division? For all powers less in naval strength than Great Britain, the naval building policy, accordingly, must be based upon a double-headed strategy. They would build against England, and they must build against powers lower in the scale than themselves. The task is indeed great for the intermediate powers. It is undeniably true, and beyond all contradiction, that the strategical considerations governing the actions of stronger or weaker fleets differ widely, but it is permitted to any one to doubt that the nation contemplating the possibility that compels it in turn to adopt either course of procedure should pursue a building policy different in each case. This is apart from the consideration of the effect geographical location, political aspirations, and the configuration of the coastline should have upon such a policy.

In the days of sailing fleets, types were few. There were not wanting, even then, advocates for especial types of vessels to be used in operations on the coastline. But generally, these types were demanded for offensive action, rather than for coast defense. Little is heard of arguments in favor of building coast defenders. When, in war, vessels were found acting in such a capacity, it was because no other rôle was possible to them. The action of the English fleets throughout the Napoleonic wars before the enemy's ports was not offensive as against the coast. Their objective generally had nothing to do with any offensive action against the coastline. It was simply and always the organized sea force that they were after, while that force existed. There was no demand, from the nature of things, for vessels other than lookouts and battleships that were suited to the ends in view. The inferior naval forces

of the continental powers were sometimes forced into the position of mere coast defenders in the narrow sense of the word. In the highest sense, the English ships were coast defenders. As before stated, it was the power inferior in naval force that was obliged to resort to their use, and the operations where they make their appearance follow the usual course and result in the defeat of the inferior force. The coast-defense vessels or gunboats of the Danes, about which a great deal is heard, found their successes in attacking commerce passing by the shores of their country, or in surprising solitary vessels of war. Defeat was their portion when under the guns of Copenhagen.

In the Civil War, such actions were more frequent than any others, and vessels of especial types, frequently very defective, were pitted often against one another. The conspicuous instance of success to the coast defender was the case of the Merrimac before the appearance of the Monitor. In that instance the Merrimac possessed an overwhelming superiority over her enemies. She brought to the action a perfect defense, behind which was developed a maximum of offense in her guns and ram, as compared to her enemy's wooden frigates. The monitors never appear during the war as a present factor in coast defenses. Their action was on the first line of defense in every case where they were employed. Perhaps a fine distinction can here be drawn between the offensive and defensive actions of vessels such as the monitors. As rapidly as they could be built they were sent to the Southern seaboard. There they fulfilled in the completest manner imaginable the duties of coast defenders, but not in the sense of the old line of battleships and frigates. They did not generally watch off the ports, waiting and anticipating the exit of vessels, but put themselves in direct competition with coast defenses and endeavored to strike directly at the enemy. While their object was not avowedly the protection of the northern coastline, it was that object which they, in connection with the main body of the Northern fleets, fully accomplished. It was not popularly recognized at the time just what they were doing; they were supposed to be acting on the offensive exclusively, and in doing so neglecting the duty of guarding the ports of the North.

The President and Navy Department were besieged with petitions and claims that some of these vessels, as rapidly as

they were finished, should be detailed for the protection of the ports of the North. It is well to remember that no vessel or vessels of the Confederate service during that conflict had any serious influence upon the course of the conflict in the waters they were especially charged with protecting, nor did anything occur during the war to show that our vessels were not in their proper positions as before stated. These requests, made as they were over the names of men prominent in official life, must have caused a serious embarrassment to those charged with directing the naval policy of the government.

The Governor of New York State writes as follows: "The subject is of the greatest importance, and I therefore feel it my duty to renew my request, and to make it directly to you, not because the Navy Department has shown an indisposition to act, but because of the importance of the measure to the interests of the city and state of New York and the country, that if the abilities of the Navy Department will not permit a compliance, your excellency will direct that provision be otherwise made to meet this important necessity. What I desire is that an armed ironclad steamer be sent to New York to defend its harbor, and that the necessary order to that end be given by you. The people of New York are alarmed already, but they would be much more so if the defenseless condition of the city was more fully know to them." Secretary Welles had written that "The steamer referred to was probably the New Ironsides, now at Philadelphia, where her presence is most earnestly requested by Governor Curtin. The Galena and Monitor are guarding the entrance to the James River in anticipation of the Merrimac No. 2. Under these circumstances it would seem to be impossible to comply with your request."

The Board of Trade of Boston, in a memorial to the Navy Department, after recapitulating the defenseless condition of Boston, only 153 guns being mounted, and the vulnerability of Boston to an ironclad by Broad Sound, said: "In view of the foregoing facts, we beg respectfully to suggest that the new ironclad steamer Nahant (of the Monitor class), now nearly completed by Mr. Loring, be allowed to remain in this harbor for its defense, at least until the necessary guns are placed in the several fortifications of the harbor and the pirate Alabama had been either captured or destroyed, provided that such dis-

posal of the Nahant be, in any reasonable degree, compatible with the immediate or more important requirements of some other branch of the public service."

The Marine Society of Boston followed with a similar petition.

Many French officers of rank, writers on naval matters, display a marked affection for coast-defense vessels, gardes-côtes, but it is to be noticed that the particular qualities they admire in gardes-côtes are those which make them very desirable for the guerre-des-côtes on some other coast. One of them deplores the lack of such vessels during the war of 1870. With them the courses of the Jahde, the Elbe, and the Weser might have become the scene of some very interesting operations. It is to be noticed further that all, or nearly all, of the examples to which they appeal to support their belief in such vessels are drawn from offensive actions, such as the actions of the Allied flotillas in the Sea of Azof in 1855; those of the Mississippi and Red River flotillas, and others; while for their utility in coast defense the arguments are largely theoretical. Other names frequently given to the garde-côtes, flotte de siège, garde-côte or garde-côtes—offensives, are indicative of the uses to which they are to be put.

Admiral Farragut, at Mobile Bay, waited for the monitors before making his attack. Admiral Sir Charles Napier delayed his operations in the Baltic waiting for especial vessels. In our service, the vessels of especial types for coast service are monitors, torpedo vessels, and rams. Certain qualities have been sacrificed in these monitors, while others as certainly have been enhanced. They are intended for coast service and should be and are classed as coast-defense vessels. I have heard no opinion that they are fitted for war in the open. They need no description, but it may not be out of place to enumerate some of their powers and limitations. Their merits are the steady gun platform in smooth water; the insignificant comparative target; the ideal of protection; the defense against ramming in those having an overhang, and it is rightly contended that without the overhang they are not monitors in the original sense; the nearly all-around fire; the flat floor; and the shallow draft. In the monitor type as at present understood, the faults may be stated to be, the exposure of the long chases of the guns to injury; the low command of the guns;

the small number of guns; the exposure of the under-water compartments owing to the fact that there is the single deck over them; and without the overhang, the liability equally with other vessels to ramming attacks; and as the freeboard becomes greater, their still further exposure. It will be observed that without the overhang, with the longer guns and with the greater freeboard, many of the essential saving principles of the old monitors are wanting. Speed not being desired perhaps, another thing can be set down to their credit, that of much less cost than a battleship of the same displacement. Putting aside the question of their usefulness in the Civil War offensively on the Southern coasts, it may be that their sphere would be found in offensive operations on the coasts contiguous with or adjacent to our own. They could operate in such waters as the Golden Gate, the Mississippi, the Chesapeake, the Delaware, and Long Island Sound, where the problem of local defense by fixed defenses is perhaps somewhat indeterminate, and lastly, they could take their place in harbor defense either as resisting an attack or in attempts to break the blockade.

It is possible, as is often suggested, that the presence of only a few of them might allay the feeling of anxiety in those who demand a local naval defense. Great stress is laid upon their shallow draft combined with their long range ordnance, which will enable them from a position of comparative safety to keep up a damaging fire upon an adversary. The monitor type, or the type known as the monitor type, while fulfilling in this country the idea attached to coast-defense vessels, is also the official embodiment of the harbor-defense idea. One function of harbor defense vessels is to be fulfilled (as before stated) as an element of defense in wide waters incapable of defense by fixed defenses. Another and a similar function is in the defense in front of open coast towns or cities equally incapable of being otherwise efficiently defended.

It is not understood that it is claimed for monitors that their manifest good qualities under certain conditions would serve them in the general service in the open sea. In a seaway it is not claimed that their turret guns can be served to windward effectively, which is a limitation not placed on ordinary battleships. Their guns may be fired, but the target would need be very big and very close. The question as to their superiority

over an ordinary battleship is so far a matter not wholly of experience but of opinion, but they are not fitted for the line of battle. In offensive actions against fixed defenses they have proved themselves to say the least, inefficient, though they have displayed remarkable passive defensive qualities in preserving their own hull when under fire.

In the case assumed of their use in the Chesapeake Bay, which was advocated at one time as a place requiring such defense, how many of them would be required to prevent the entrance of a war fleet? It is frankly admitted that the mouth of the Chesapeake is indefensible otherwise. Can it be assumed that one vessel of such a type in view of its slow firing battery, or rather, weak intensity of fire, can be matched against more than two battleships? The floating battery may retire into shallow water, but wherever it can hit it can be hit, and the shallow water will not prevent torpedoes from reaching her, if she is hotly engaged with two or more vessels. It has been suggested that she might retire behind the works at Hampton Roads, and that no fleet would dare proceed up the bay leaving two of them in its rear? What is the difference between fighting them going in or turning around and fighting them if they approach from the rear?

Another point suspected before, but fully developed by the English manouvres of 1892, was that the coast-defense vessels required the almost undivided attention of the coast-defense torpedo-boats for their protection. The rôle of torpedo-boats is well known now, and generally acknowledged to be principally in coast and harbor defense. If they are protecting floating batteries they have lost their character. It is not inaccurate to state that coast-defense vessels are more exposed to torpedo attack than any other class of vessel. The defense against such an attack lies in great mobility and an intense rapid fire. The first of these is not claimed in them and the last is totally absent. If separated for any reason from a base, their extremely limited coal-supply will be rapidly exhausted through the use of mobility forced upon them in the presence of torpedo-boats and vessels. At anchor or in the vicinity of an enemy, they will require all the paraphernalia to guard against torpedo-boats—nets, obstructions and mines—that are forced upon any vessel so situated, and just by so much are the other defenses

weakened. As batteries, the defects and limitations of ships are placed upon them; and as vessels there are imposed upon them also some of the defects of batteries in the quest for invulnerability. Unless accompanied by colliers, the coal-supply of monitors generally is too limited to admit of any great radius of offensive action away from their own coast. During the Spanish-American War two of them accompanied the United States squadron to Porto Rico early in May, and for portions of the distance they were towed by other vessels in order to avoid frequent coaling, thus diminishing the speed of the squadron. The outward and return runs were thus made slower, and had the Spanish Admiral not been hampered on his voyage from the Cape de Verdes by his torpedo-destroyers, which also required towing, he might have succeeded in reaching Havana while the one squadron was at Hampton Roads or en route south, and the other returning from San Juan. The monitors were considered as "very inefficient" for off-shore or distant work, due to their inherent qualities.

There is the case of their action as partaking in the defense of a fortified harbor. It is probable that from their mobility they might take positions of great tactical value, undoubtedly such positions will be at different points during the progress of an engagement. It can be imagined, however, that a skilfull enemy might use them as a cover, two of them might engage one closely, thus paralyzing the fire from the works. Their position will be limited to supporting distance of the works, otherwise they might be cut off; for the same reason they cannot follow the enemy where they would sacrifice the advantages of their light draft. If permanent defenses are not sufficient to deter or forbid an attack, one or two floating batteries will not; and in building vessels for coast defense, in the narrow sense, there is no doubt that the line of battle is just so much weakened. When all is said for and against them, there remains the fact that they may possess an undeniable value in their field of action. The question is as to the relative prominence to be assigned them in a naval policy. Torpedo vessels, dynamite vessels, gunboats, rams, and submarine vessels may be classed as coast-defense vessels, in the narrow sense, in addition to monitors. The submarine boat, the dynamite cruiser, and submarine gunboat may be regarded

as varieties of the torpedo-boat, as yet undeveloped, which may prove to possess what may be the vital requisites for coast-defense vessels—the possession in themselves of an undoubted superiority over an enemy—replacing with highly developed powers in one direction the ability everywhere to present greater numbers of equal types to the enemy.

Gunboats have found favor with all nations, and fill a double rôle. They can be used in shallow waters abroad, or in shallow waters at home—they are an essential in time of peace and valuable adjuncts in time of war. In our Civil War they proved invaluable. We have not given ourselves over to the policy of building armored gunboats as have other nations, notably the French, and there appear no good reasons for doing so. In coast attack a few of them are equal in gun strength to a large vessel, and possess greater mobility, at the same time offering a smaller target. Concerning them, a distinguished officer, Sir George Elliott, K. C. B., has said: "There can be no doubt that, in future wars, shore batteries will have so far obtained superiority over ships that close engagements will be avoided by the latter and that bombardment at long ranges will be resorted to where it is deemed operative, in which mode of attack a flotilla protected by ships will bear a conspicuous part."

He holds that the gunboats would stand their ground in defense in shore or under the protection of their batteries, and should maintain their position end on. They should be stationed in different ports ready to concentrate, and should be manned by volunteers. He dwells upon the power of these vessels to assume the offensive as suggested above in flotillas. "If a gunboat flotilla had been sent with the fleet to Cronstadt (referring to the first expedition to the Baltic during the Crimean War) the north passage of that island might have been cleared of obstructions, and a sufficient force have gone up to St. Petersburg to have dictated terms of peace. . . . Some efforts were made on the spot to improvise a flotilla force by mounting guns in harbor craft . . . captured for that purpose, but it was too late that year, and the following year, when some gunboats accompanied the fleet, the Russians had found out their weak point, and by taking locomotive engines off their railways, showed front with twenty-seven gunboats mounting heavy guns

against about half that number which England had provided. . . . When too late, some one hundred and twenty gunboats were produced."

He claims that torpedo vessels alone are not able to prevent distant bombardment, and that the tactics of the gunboats would be dispersion, a frequent change in range, and retreat into shoal water. The torpedo vessel is a recognized element of coast defense, and it is confidently believed that its full value has not been developed at the present time. The torpedo itself has become a new weapon since its range has been doubled, while its accuracy has become marvelous, and it cannot be doubted that these facts will bring about an entire revision of our idea of the weapon, its tactical development, and its place in maritime warfare. Other floating elements of coast defense are not touched upon in these pages, as they may be considered to be in the experimental stages. It is a wise government which spends money freely in fostering and in developing the warlike conceptions brought to its notice, where such conceptions appear to possess merit, for if worthless, they are easily exposed under governmental inspection.

We must not look to see the art of naval warfare so revolutionized at once that the force inferior in sea-keeping battleships will, with the aid of exceptional vessels unfit to take a place in the battle line, reverse the natural and historical order of things. Although such vessels may enhance greatly the difficulties which the force attacking a coast must encounter.

Several years ago the French ships Amiral Duperré and Sfax carried out some experimental firing against a specially erected fortification on the "Ile de Levant," in accordance with an agreement arrived at between the navy and war departments.

"The Amiral Duperré and Sfax had each been directed to carry out several series of firing, during which the course, the speed, the end to be achieved and the nature of firing were changed, each series occupying about three-quarters of an hour. During the experiments, which lasted altogether six hours, more than 1000 shots were fired from guns of 34 centimeters, 16 centimeters, 14 centimeters, and 10 centimeters (13.3 inches, 6.2 inches, 5.5 inches and 3.9 inches), which works out a little over two shots a minute per ship. A certain number of shells were filled with melinite. As it was necessary to examine the effects

of the fire after each series, the experiments had to be spread over a period of three days.

"The fortifications consisted of two batteries constructed by the engineers after the most approved fashion, and in which were represented very accurately, by models and dummies, the guns with their gun detachments and accessories. In each battery was simulated an armament of eight guns, four of heavy and four of medium calibre. One of the batteries on the slope of the island had an altitude of 65 feet; the second, crowning the crest of the island, had a command of about 328 feet. More than half the dummies of the gun detachments were hit, and about one quarter of the guns were dismounted or more or less damaged. The harm done to the forts themselves was insignificant, both from the shells filled with melinite and those filled with black powder. The melinite shells, which burst into very small pieces, would have been particularly deadly to the personnel. Some fragments were found at more than 1000 yards from the batteries, proving the enormous initial velocity produced by the explosion.

"Attention might be called to the advantage that forts possess in being able to draw on a practically unlimited supply both of men and ammunition, and also that the defense would continue as long as the work is tenable and a gun remains fit to fire. To dismount a few guns and put out of action a fair number of gunners (who could be replaced from others held in reserve), it is estimated that the Sfax and the Amiral Duperré found it necessary to fire 39 tons weight of projectiles. During the last Continental War, it was calculated that for every man killed, his weight in metal had to be fired, but the experiments under consideration not less than nine or ten times his weight in metal was required to remove one man of the defense. Such are the disadvantageous conditions under which ships are placed when contending against well-constructed fortifications. If, on the other hand, we suppose that the sixteen guns which served as a target had replied to the fire of the Amiral Duperré and the Sfax, we may presume that the two vessels would have been several times hit and have received some serious damage. A single shell of 240 millimeters (9.5 inches) fired from the commanding position of the battery on the crest would have been most dangerous to the armored decks, and in any case would have produced destructive results."

The feature of mobility for the armament of shore defenses so strongly urged by some engineers, is one which appears upon investigation to be highly desirable. In such a harbor, for example, as New York, on Staten Island, Long Island, Coney Island, or on Sandy Hook, a little extra preparation of cars for transporting guns would enable moderate sized ordnance to be moved from place to place where mounts had been established with the necessary cover and invisibility, and the system should be very perfect. Experiments have been made in India in firing guns from ordinary platform cars without much preparation as regards the trucks, and at all angles with the track. The commission charged with the experiment concluded that specially built cars on ordinary rails could easily support the firing of 6-inch guns. The gauge was 3 feet 4 inches, and the rails were not reinforced in any way. The 81-ton gun has been fired on rails in England, and there seems no reason why an ordinary truck might not be specially prepared to take such carriages. It seems also a most important requirement for coast defenses that there should be a ceinture railroad in connection with them, just as such a system of rail communication is deemed of such vital importance in national defense, to provide rapid movement to the threatened points of bodies of troops. The demands of trade and intercourse in this country have produced a system almost perfect throughout the country without having had recourse to the construction of so-called military roads as in other countries.

The advantages of the ability to move ordnance from one point to another, in addition to the transport of troops to a threatened point, and the supply of ammunition, are too obvious to need much attention. In case vessels concentrate their efforts on one point, such mobility on shore enables a concentration to be made to meet it. If the range or location of a light battery is so accurately known as to make its position untenable, it can be abandoned for another location should the rapid-fire guns have rail carriages designed for them with this object in view. A distinct advantage possessed by rapid-fire guns on shore over those afloat is to be found in the opinion expressed by makers of such guns, that not being limited by space for guns or ammunition, it is practicable to give the guns any desirable length. Canet has put forward tables for guns

up to 100 calibres in length. While the increase in the rate of fire of rapid-fire guns is equivalent to an increase in number up to a certain limit, the number of rapid-fire guns for coast defenses need not, and should not, be restricted. The ability conferred by steam, enabling vessels to run rapidly out of one zone of fire, should be met by an increase in the number of guns and their own power of motion.

Another important element in harbor defenses is known as vertical fire, and the indications are that it will possibly take a preponderating importance in future coast warfare. The use of shells in vertical fire long antedates their use in so-called shell guns.

The first reference to such use in bomb vessels goes back to the siege of Algiers in 1685. It was the suggestion of a Mr. Reyneu.

In the wars of the last century, mortars and howitzers were freely used, but almost altogether in the attack upon fortified positions, and such has been the case even down to the present. The reason probaly lies in the fact that the fire was considered so inaccurate that it was deemed effective only against works offering a large superficial area.

The value and importance of mortar fire in the Civil War was fully appreciated, and, since that war, both in Europe and this country, successful efforts have been made to develop all the possibilities of vertical fire, until now in its particular applications to coast defenses, engineers the world over are able to say that vessels cannot anchor in order to carry on a siege while exposed to the fire of properly installed mortar batteries.

In a valuable report made by General Gillmore after the siege of Fort Pulaski, at the mouth of the Tybee River, an interesting idea is gained of the estimate placed upon mortar fire at that time. The siege took place in 1862, and great disappointment was felt and expressed regarding the performance of the mortars of 13-inch calibre, for although the circumstances were peculiarly unfavorable to the mortars, the net result was that not one-tenth of the shell from the mortars fell within the work, which was a pentagonal work of considerable size designed to mount 140 guns. The 13-inch mortars were fired at ranges between 2650 yards and 3400 yards, such ranges then being considered too great for effective work.

General Gillmore concluded that mortars were unreliable for the reduction of good casemated works of small area, and believed they could play an important part in the reduction of a work with wooden buildings which might be set on fire, or in silencing barbette batteries. In addition, he recognized their value for the reduction of fortified towns and cities, but suggested that rifled guns fired with high elevation might be better suited to the work. This opinion was a keen forecast of what has since been accomplished in the development of mortars.

If we look at the causes of this poor practice, it is not quite clear why any disappointment should have been felt. The mortars were placed after almost superhuman efforts on soft ground, on improvised platforms, which, however, behaved better than could have been expected. The powder used was reported as being defective, and there being no standard copper measures, it was weighed out in tomato cans. No one thing affects mortar fire more disastrously than inequalities in the charges of powder used. The gunners had never fired before, the wind was entirely unfavorable to the practice, and owing to the length of flight this was also a very serious disturbing cause. Some 10-inch mortars, ranged at 1650 yards for some reason, gave far better results, dropping something less than one-half their shell inside the work, the total number of mortar shells fired having been 1732. Evidently too low an estimate was formed as to the accuracy of mortars in this case, or else too much was expected of them under the circumstances.

Many experiments have been carried out to develop and test this class of fire, principally at Meppen, though the Russians, Italians and Japanese have been very active in experimental work. The majority of the experiments, however, have been carried out with a view more to test and secure penetration of the projectile through targets representing the protective decks of existing types of vessels. The desire appears to have been to secure penetration through the deck before the explosion took place in order that the machinery, or magazines, or other vital points might be struck or destroyed; some even having looked to the penetration or destruction of bottom plates of the vessel or of the propellers or the rudder. Some experiments carried out at Meppen in 1879 were interesting in themselves both for the accuracy shown to be possible at that time

and from the rigid mathematical analysis to which the results were subjected. The commission reported as follows: "From all this we think it may be concluded, if the probable errors which may be met are considered, that the probability of striking the deck of a vessel with curved fire is, notwithstanding the great accuracy obtained, pretty limited for large distances and rather large for distances between 2187 yards and 3281 yards. Remembering that many guns may at once be fired against a vessel, and considering the effect that a single heavy projectile may produce in the vital part of a vessel by striking its deck, we can but feel the necessity of opposing an efficient resistance against curved fires, which are, without doubt, sufficiently serious to a fleet that desires to act against a coast."

Captain Barabino, of the Italian Artillery, taking up the question here, says: "It remains to consider the probability of hitting with curved fire a vessel which moves in any direction with a given velocity. I do not think that in a real attack against a fixed object in which many vessels take part they can manoeuvre with a velocity approaching that of their ordinary movement. They are prevented in their evolutions in the midst of smoke, and in a relatively small area by the wish to maintain their proper distance of fire; and to prevent collision, an occurence that is more probable the greater the number of types of vessels, the nearer the shore, and the greater their radii of evolution is. Yet it is necessary to admit as possible that a squadron may carry on a bombardment keeping up a velocity of about six miles, and this velocity, by which a vessel displaces itself during the time of flights of projectiles, has an injurious effect upon the probability of hitting."

The results as given by vertical fire from the French 22-cm. howitzer for ranges up to 4000 meters, and from the curved fire from 24-cm. Italian guns up to 9000 meters, were subjected to analysis on the theory of probabilities, the conclusions being expressed thus: "In other words we can admit the probability of hitting with shell curved fire from the 24-cm. rifle up to 9000 meters will not be less than 2 or 3 per cent, when we take for a target the deck of a vessel moving with a velocity of six miles an hour. The results, which at first view seem poor, do not seem so when we consider the condition in which a squadron is relative to a coast battery while at such a distance away,

that it cannot harm it, and consider the immensely destructive effects that a successful shot from the shore may produce on the vessel struck. The expermients on the Guerriera . . . . make it probable that two large projectiles which burst after penetrating an armored deck would be sufficient to make the vessel withdraw from action; and the withdrawal by one vessel of the squadron and the incessant rain of heavy projectiles against the one or more still remaining seem sufficient to demoralize the crews. As in a battle on land, a tactical unit is considered disorganized when it has lost from one-third to one-fourth of its strength, so I believe that an attacking squadron would cease bombarding if two or three of its vessels were forced to retire by the curved fire of seacoast artillery."

The results of experimental high-angle fire as carried out in England have not been accessible to the writer.

An English author, however, an engineer, says concerning the early experiments with the 9-inch polygrooved gun, muzzle-loader, that " They were remarkably successful and proved that, thanks to the position finder (Watkins), it would be impossible for a ship to anchor at 8000 yards from such guns without receiving frequent deck hits of a dangerous nature. Even against a ship in motion the chances of obtaining such hits are considerable, and it may be taken as established that no vessel afloat would dare to remain under the fire of small groups of these guns."

In 1891 the Japanese made some experiments for penetration and fuse action, against a target representing a section of the protective deck of one of their new vessels. The accuracy was not remarkable, twenty per cent of hits being scored against the whole extent of deck, the range having been 3773 yards. Former experiments at Bucharest gave a percentage of hits under similar conditions of 22 to 23 per cent.

All these experiments and many others have been made under peace conditions and under the most favorable terms, while others have been made especially at Spezzia, at moving targets which appear to have been very successful; at any rate, the Italian coast as a result of these experiments is well provided with howitzers and their mounts.

Concerning the accuracy of vertical fire, it is proper to note that the size of the rectangle made in any stated practice de-

pends upon the nicety of the mechanism of the guns and carriages; upon the regularity in the charge and projectile, and upon the proper estimation of range and correction of the incidental errors due to the wind, barometer and time of flight. From the character of a high trajectory, it becomes the more important to have the most accurate determination of the range on account of the short danger space, which is little more than the length of the target in the plane of fire. The time of flight requires careful allowance for deviations caused by wind and change in the location of the target; the fact that the errors in high-angle pointing are exaggerated over those in direct pointing, requires either the nicest mechanism or the multiplication in the number of mortars. It is evident from the few experiments referred to with mortar fire that, should the elevation and other factors remain constant throughout a string of shots, the rectangle enclosing all the hits will not be so very large. In the use of vertical fire in sea-coast defenses, the vital point is to be able to place the rectangle where it is wanted, and to accomplish this an efficient system of range and position finding is absolutely essential, as well as absolute uniformity in powder. On shore there is no limit placed upon the application of range and position finders. The stations can be in the most favorable locations, observation points where wanted, and the communication with the gun can be made in any manner desirable. There being no occasion for any exposure whatever of mortars, there is no reason for their dispersion, and by grouping them they can be pointed and treated as one mortar under the direction of one officer. The individual rectangles can thus be made to overlap and supplement one another. There is a concurrence amongst engineers, both English and American, in limiting the number of mortars in a group to four. It is further desirable to assemble a number of groups to make an overlapping of the group rectangles, the disposition of such groups depending upon the results of experimental practice in making rectangles. There is also a concurrence in assigning four groups of mortars to a battery—thus the number of mortars in such a battery will be 16, subject to the direction of one officer and avoiding a multiplication of communications of ranges, which could only be confusing. Mortars being comparatively cheap, can easily be so utilized as regards numbers

as to eliminate most of the chances of not hitting. This merit of cheapness is a further argument against the use in mortars of armor-piercing projectiles of great cost. Ammunition should be unsparingly though intelligently used to gain the full effects from mortar fire. It is calculated that, to ensure penetration of existing protective decks with the larger sizes of mortars, the ranges are found to be between one mile and something over five miles. These are sufficiently wide to allow all the latitude desired in the selection of sites for mortar batteries, apart from the consideration that penetration of the protective deck is not the only essential. From considerations of the fact that if mortars are placed at a high elevation they gain almost twice that elevation in the velocity due to the fall of the projectile, some engineers have been lead to advocate high sites for them; but as high sites wherever available should be utilized for the main armament of guns furnishing horizontal fire, and as the one armament should not be exposed with the other, it does not seem important that mortars should be placed on high sites, though it is certainly desirable. Mortars finding their best sphere of action at the greater ranges, fill exactly the weak place in horizontal fire against armor, besides, as it were, turning the flank of the armor. They do not in any way take the place of horizontal fire directed against unarmored portions of the hull of vessels, which fire is effective at all ranges.

If the mortar batteries are near the shore line with a deep-water channel close in, there will be a point about one mile distant where the elevation will have to be so great in order to procure sufficient velocity of fall, where the inaccuracies will also be increased, and where there is a chance owing to the extreme elevation that the projectile will fall base first that it will be necessary to discontinue their use at that range, and to turn them again upon such vessels as happen to be at the outer ranges. If the mortar batteries are retired, or there is shoal water in their front, ships may be under their fire continually. By retiring the batteries and studying the shore line, it may be possible to make them serve the double purpose of operating over the water approach and over possible neighboring anchorages, which might otherwise be occupied by hostile vessels.

In narrow entrances where vessels may pass at speed on a

chord to their arc of fire, their use is not indicated. If they must pass on the arc, the mortars would then be at the extreme of their usefulness. In such passages, if the batteries can be located at varying distances, sufficiently great, on or near the prolongation of the passage, they would fill a part which could be filled by no other character of guns; and if the conditions of the passage render navigation difficult, or if it be obstructed, they could almost certainly forbid the entrance.

Yet another tactical use for mortar batteries well withdrawn suggested by a French naval officer, is to cover the dead angle in cases where the character of the coast requires direct firing batteries to be mounted upon a height. Mortar batteries properly dispersed could drop their shell over just that position of the water front uncovered by the direct firing guns.

The seacoast fortifications of the United States have undergone several well-marked stages of development, limited generally, as can be imagined, to the eras succeeding war; the time preceding the War of the Revolution, and during its continuance, producing what has been termed the first system. It comprised light works of little value, and included all the works projected or actually built at that time. The second system comprised the works built under appropriations made prior to the War of 1812, and are described by competent authority (General Totten) to have been, while numerous and widely distributed along the coast, "small and weak, being built for the sake of present economy, of cheap materials and workmanship, were very perishable."

Subsequent to that war, the moral having been drawn from the experience beginning with 1816, the government proceeded regularly with the work of the building up of the harbor defenses. Appropriations were forthcoming, the work of construction went systematically along, under a well-developed scheme, which was only interfered with from time to time by Congress. A statement in a report made by General Totten, Chief of Engineers, throws some light on the tendency of localities to claim precedence to the detriment of any well-devised plan, as follows: "The order has been well observed generally in the execution of the system with the exception of some cases in which, by the action of Congress, certain facts were advanced out of the order advised by the board."

This interference seems to be an evil inherent, and unavoidable, not alone perhaps in our institutions, but with us it may be attributed to the wide extent of the country and the consequent apparent separation of the interests of localities. There is reason to hope that a better era has long since begun.

During the progress of construction of the third system of harbor defense—the one that has existed down to the present day—upon occasions where engineers had to do with sites calling for dockyards or naval depots, naval officers of rank have been associated with them. This system furnished the harbors and points on the frontier with numerous strong works, generally of masonry. Command of batteries was not deemed important, the advantages flowing from the use of ricochet fire with smooth-bore ordnance outweighing other considerations. Thus the fortifications were placed mostly à fleur d'eau, while land forts were provided to enable a siege in rear of moderate duration to be sustained, and in some cases to withstand a very extended siege. It was recognized that masonry was not sufficient to sustain fire from siege guns on shore, consequently earth was placed upon the land fronts, but masonry was deemed sufficient against the inaccuracies and limitations imposed upon the guns of the day when afloat.

In consequence of the effort made, the harbors of the coast were placed in a remarkable state of defensive efficiency for the smooth-bore era preceding the Civil War; but during that war, however, the larger calibres of smooth-bore guns and the use of rifles demonstrated the inadequacy of masonry casemates. Some of the works while remarkably fine examples of the art of the engineer, seem to have gone far beyond anything that the circumstances of the day of their design, or any other day for that matter, could have warranted, and illustrate finely the intermittent liberality of Congress. Their construction was justified perhaps by the apparent urgency of the time, which resulted in the calling to the assistance of our engineers the aid of French engineers. In the fifteen years succeeding 1860, the system was developed on the same lines, being an outgrowth and enlargement of that system, but about the year 1875 appropriations ceased and were not again made for seacoast defenses until the year 1890, when appropriations were resumed and have since been expended in modernizing the system.

The objects which the engineers had in view in the development of the system called the third system can be stated best in the formal language constantly used for many years in their official reports. They classed in relative importance the means for defense as, first, a navy; second, fortifications; third, interior communication; and fourth, a regular army and well organized militia. The objects and purposes are stated thus: "The navy must be provided with suitable establishments for construction and repair; stations; harbors of rendezvous, and ports of refuge, all secured by fortifications defended by regular troops and militia, and supplied with men and materials by the line of intercommunication. Fortifications must close all important harbors against an enemy, and secure them to our military and merchant marine. Second, must deprive an enemy of all strong positions where, protected by naval superiority, he might fix permanent quarters in our territory, maintain himself during the war, and keep the whole frontier in perpetual alarm. Third, must cover the great cities from attack; fourth, must prevent, as far as practicable, the great arms of interior navigation being blockaded at their entrance into the ocean; fifth, must cover the coastwise and interior navigation by closing the harbors and the several inlets from the sea which intersect the lines of communication, and thereby further aid the navy in protecting the navigation of the country; and sixth, must protect the great naval establishments. Interior communications will conduct with certainty the necessary supplies of all sorts to the stations, harbors of refuge and rendezvous, and the establishments for construction and repair, for the use both of the fortifications and of the navy; will greatly facilitate and expedite the concentration of military force and the transfer of troops from one point to another; insure to these also unfailing supplies of every description and will preserve unimpaired, the interchange of domestic commerce during periods of the most active external warfare." As this presentation exhibits the objects to be attained by coast defenses so far as effected by fortifications and organization, it will perhaps be well for future reference to state them more tersely. The first clause, so treated, states that naval arsenals should be secured for the service of our own navy. The second means that no place shall be left uncovered by fortifications where a hostile force under cover of naval

superiority could gain a foothold. The third refers to interior communications in their relation to the logistics of the question.

In general, harbors or ports derive a military importance, which is strategic, from their location considered with reference to their location on the national coastline; to their location relative to the strategic points of a foreign coastline, their relation to interior strategic centres of support, and they have an importance of their own tactically considered. Strategic considerations alone may determine that a point deficient in tactical possibilities should receive full development, for instance, such a point as Cherbourg in France, or Key West, or Tortugas, perhaps The Race off New London. This, while true of the positions on the mainland, is especially true of insular positions.

Naval arsenals imperatively demand permanent, natural, or artificial defenses of the first order, otherwise there is little or no reason for their existence; we would simply have built for others, the question so far being simple, as long as we are inferior at sea. In the selection of such points for the construction of arsenals or navy yards, every strategic characteristic should be carefully taken into consideration, and at such points so selected we should expect to find a remarkable combination of properties. Generally speaking, the requirements for such positions contemplate, first, as regards their geographic location, that they should form advantageous bases for naval operations. This requires a careful consideration of our own and foreign trade waters; the location, distance and direction of foreign bases of operations; and the geographic relation the position holds as regards the mouths of rivers, other great ports, and harbors of refuge. Some positions fulfilling perfectly these qualifications are yet lacking in other essentials which go to make a site for an arsenal, suitable in all respects. The harbor selected must offer a depth of water suited to the heaviest vessels seeking it, the currents or tides must also be moderate and advantageous, and the water must be of enough depth along a sufficient frontage to admit of wharfage for any number of vessels likely to need it. The place selected must furnish sites for the heaviest buildings and be suited for the construction of dry docks, labor must be plentiful and easily attainable, while supplies of all kinds and good water should

be at hand. Manufactured products and raw material of the necessary descriptions should also be convenient, and free and easy communication with the interior and other centres is indispensable. The climate should favor health and labor, and lastly the position should favor easy defense and be tactically good.

As a general rule only great cities at the exits of great water routes fulfill all these conditions, while the same combination of qualities is rarely characteristic of other localities except in new territories, where it happens that in providing naval arsenals with fortifications many other objects will be fulfilled. In addition to the arsenals, the great cities will be freed as far as may be from possible insult. The pivotal points on the seaboard of the great interior and exterior carrying trade routes will be secured, and the natural bases for naval operations for offense or for concentration will be held for ourselves as against possible enemies. Should the site not comprehend all these features, it will yet be a point from which to strike the enemy, and should include as many of the requisites as possibly can be secured. The following places then can be disposed of as requiring fixed and mobile defenses of a high order: Portsmouth, N. H.; Boston, Mass.; New York, N. Y.; San Francisco, Cal.; Philadelphia, Pa.; Norfolk, Va.; Washington, D. C.; Port Orchard, Wash.; Port Royal, S. C.; Key West, Fla.; New Orleans, La. The character of these defenses should be modified or proportioned according as the draft of water permits them to be subjected to a greater or less attack. Portsmouth, Hampton Roads, Key West, San Francisco, and Puget Sound are exposed to an attack by vessels of any draft. Boston, New York, New Orleans are exposed to close attack by vessels of a less draft than 26 feet. Philadelphia, Norfolk and Port Royal are exposed to an attack by vessels of a less draft than 23 feet. Washington to an attack only by vessels drawing less than 20 feet.

It is perfectly certain that permanent defenses having been provided covering these points upon which the navy depends for its existence, that the work should not stop there. The question then arises, granting that all vulnerable points of the enormous extent of our coastline cannot be liberally protected by permanent defenses, what points shall be afforded such pro-

tection and to what extent? It is a great question to answer which requires an equipment of ability and study of the particular subject belonging peculiarly to but few people. The task cannot be attempted here other than the suggestion of a few propositions. There are strategic points independent of those mentioned, and there are numerous coast cities and towns of all degrees of wealth, importance and accessibility. There is the idea of reserving certain harbors for our navy and belated merchant shipping while refusing them to our enemy. To repel or forbid an attack in force, the permanent defenses should be of the highest order, while to repel or forbid a raiding attack, they need be very slight. Cruisers can be deterred from attacking, or can be repelled in attack, by a few guns judiciously placed and covered.

There is a tradition that for the protection of coast cities the works should be proportioned to the wealth to be covered. That for a city representing so many millions of accumulated riches the works should be of such and such a degree of magnitude, that for a city representing half that value the works should be of a strength or value of one-half as much, in other words, the cost of the works is a per cent of the assessed value covered. It seems that this establishes inherently a false standard, for will the attack proportion its offensive strength on any such assumption? It would seem more rational to assume then that there are but two degrees of strength to be given to defensive works. One, as against an attack in force—the strength of the attack depending upon the accessibility of the place to be protected, in the matter of depth and area of the water approach—the other as against a raiding attack by cruisers. An intermediate degree of strength would be contemptible against an attack in force, and overwhelming and costly against cruisers. It would also seem a fair assumption that places which could be bombarded by vessels from situations comparatively free from danger—that is, such places as are directly on an open coast—should not receive any protection from permanent defenses, for the resistance offered by such places surely draws upon them the hardships of war. Their peaceful character in the absence of such resistance is the best safeguard—Admiral Aube to the contrary—the weight of experience and civilized opinion being all against the bombard-

ment of peaceful towns. To assemble further some conclusions that may clear the air in this most intricate question, it is suggested that landings cannot be prevented, for an enemy can always get a footing on the coast where unprotected if the naval strength falls below a certain standard; and further, that permanent defenses can do nothing beyond refusing an entrance in certain places to a hostile squadron—defenses cannot raise a blockade, and they have no influence beyond the area covered by their guns. This last proposition needs perhaps further elucidation. There is no danger to a fleet involved in the fact of having fortifications in its rear. Seacoast defenses do not threaten an army of invasion passing them in rear, in the sense that a fortified strategic land position threatens an army passing it and leaving it in rear, unless the seacoast defenses shelter a larger garrison or an army which is not contemplated. If the works shelter or promise to shelter a defensive fleet, an attacking fleet would be obliged to pause and deal with that fleet; but it will be observed that as in a land fortress, it is the mobile force, the army, that constitutes the check; so in the seacoast fortress, it is the fleet that accomplishes the same object.

The northeastern section of our coastline from its extreme boundary to New York, offers a continuous line of harbors, accessible at all seasons to vessels of all descriptions. Winter gales and fog but enhance the difficulties of the navigation of the coast waters, without materially altering their favorable character for naval operations in the case of steam vessels. From Cape Ann to the eastern boundary, no section of the coast is characterized by features differing from those presented by any other section of the same stretch. The coast city of the greatest value, Portland, has been the point deemed most worthy of treatment in the way of defenses. The wealth of the place and superb harbor have heretofore indicated it as the point for our strongest flanking defense in the North Atlantic. To-day no permanent works can cover or shield the city as vessels from positions of perfect safety to themselves can bombard the city. Fortifications probably can refuse the harbor to an enemy who, seeking a base on that coast, can choose amongst the others. What object, then, will the fortifications of Portland secure? The city and the shipping may be shelled by cruisers even, or the

ransom will be paid, but the desired resting point for the navy will be preserved. The strategic points threatening the adjacent coast and the trade routes to the southward are better watched from points to the westward of Cape Cod. Is Portland the fit point? This is a question that may be examined from two different standpoints. One wholly naval and connected with maritime operations only; the other and broader aspect considers the combined operations, naval and military. As fortifications at that point do not secure any safety to the city from bombardment, the reason for their existence must depend upon other considerations. As the possession of that one particular harbor over any other neighboring harbor is not essential to the purely naval operations of an enemy or of our own, we must look still further for reasons. In this long stretch of important coastline there must be some selected point as a base for our own naval operations, which shall be centrally located and not so far removed from the extremities as to hamper or forbid their support; just as circumstances of distance compelled the early occupation of Port Royal in the Civil War. The enemy may choose his base, but he must feel in case Portland is not taken that next door to him there is a menace. There can be no dallying with it nor passing it. It must be reduced as a preliminary to further movement. From that base he may be struck at any moment, and while that naval base exists the enemy is compelled to put forth great efforts for the security of his own, whether it be established on our territory or whether it be already in existence on foreign territory. A military writer, Lieutenant-Colonel Wagner, has pointed out most forcibly the extreme disadvantage under which we are placed on that portion of our own boundary, both from natural and artificial causes in case of a contest with our neighbor on that side. After a convincing argument tending to show most surely that in such a contest our most feasible and important objective for military operations would be Quebec, with Montreal as a preliminary objective, both by way of the old historic line of operations through New York State, he calls attention to the ease with which the enemy could create an important diversion and place his grasp upon a vital point of our soil. A glance at the chart will make his meaning clear. An army of invasion proceeding westward across the boundary

encounters no obstacles other than a few rivers, which are not insurmountable. If this enemy commands the sea, his left flank is securely based upon the fleet, and his communications are perfectly safe, being threatened from no direction. When the Kennebec is reached, his grasp is upon the old line of operations, the communications between the sea and the St. Lawrence. If the situation be reversed and we attempt an eastward movement, the peril is at once apparent. All the lines of communications are assembled within thirty miles of the sea and are open to attack from the enemy's fleet, and if the enemy's fleet possesses itself with a harbor well to the westward, say Portland, and entrenches himself, his purpose is nearly accomplished at one stroke. Reinforcements and supplies can be poured in from the sea, and without the reduction or masking of Portland from the side of the land, our communications are at his mercy, and no operations eastward can be made in security. Thus the weakness of our position is at once apparent. If Portland be strongly fortified (the plant is already there) and a naval force in existence, the advantages in the enemy's favor are largely neutralized. The key of the situation—the binding point of the land and naval forces—is secure. The enemy may advance by land and sea, but his fleet, or a portion of it, is tied to his left flank, and at some point he must stop, and contend the ground squarely. His continuance will ultimately rest upon his naval success, and in case of failure the conditions will be reversed while the advantages of the re-entering base will rest with us. One of the vital links in our chain of defense is certainly a point fitly chosen and properly fortified, and because Portland is a great city with a fine harbor for all classes of vessels; because it already has the sites and beginning of the plant; because it is near the north and south line of communication by the Kennebec Valley; and because it is a collecting and distributing point of the coast and interior, it would seem to be the fit point, although some of the tactical conditions which formerly pointed to it as the one point on the coast to be fortified have departed under modern development. Such other points on this section of the coast, entrances to harbors, mouths of rivers, harbors of refuge, should be provided with a slight defense, any serious attempt to occupy them by an enemy should not be resisted by passive defenses, for the attempt woul be futile and the results disastrous to the place.

The St. Croix River, forming a portion of our eastern boundary, empties into the Pasamaquoddy. The conditions are such that the American channel of approach (Lubec Narrows) is the poorest of all. It is full of shoals and five or six feet deep at low water. Great Britain possesses a much better entrance, thus everything facilitates the English control in war of that bay upon which Eastport is situated.

The section of the coast beginning with Cape Ann and extending to New York is probably the most remarkable of the whole Atlantic coastline, and, together with the reach to Cape Henry, it constitutes the sea frontier of the most important section of the country. It is the centre of the possible theatre of Atlantic coast warfare, the extreme flanks resting upon Maine and Florida. It can be more readily supported than either, and at the same time covers the greatest interest. Generally speaking, its physical characteristics are intermediate between those of the northeast and the southwest. The capacious harbors are less frequent than in the northeast and the question of seacoast defenses is in so far simplified.

Boston, the engineers assure us, can readily be placed in a state of perfect defense. About Massachusetts Bay and Cape Cod many strategic possibilities hinge, but nature has there provided that man cannot improve on her works. Any part of the estuary within the cape is an anchorage for a steam vessel. The cape itself is incapable of efficient passive defense. These circumstances remove the section from our sphere of discussion, except that attention is again called to the preponderating importance of a navy. Beneath the cape is the remarkable group of islands and sounds through which, or around which, passes all of the coast trade that does not find a terminus in Narragansett or Buzzards Bay. Owing to the physical conditions the region is incapable of artificial passive defense. The intricacies of navigation and the insufficient depth alone must be relied upon to embarrass an enemy. In the sounds he can readily establish himself unhindered by us except through the intervention of a naval force. The same is true of Buzzards Bay. Passing over the minor resting points of the coast, Narraganset Bay is the next break in the coast demanding attention. Fixed defenses at the main entrance with obstructions and flanking defenses in the eastern channel may interdict an entrance to a

moderate force. They cannot save Newport. They may save Providence, Bristol, and Fall River from a cruiser attack, but it is questionable, as before stated, if those objects cannot be better secured in another manner. The question then is a strategic one, the bay being remarkably placed in relation to other points of great importance and the mouth of the Thames River. A proposition before suggested seems to bear especially upon this point—that there should be no half-way treatment of the question—the defenses should stand against cruisers or against an attack in force. As a base for naval action, the bay of Newport is superbly placed, but in that respect it cannot take the place of a location nearer the mouth of Long Island Sound. If fixed defenses do not cover the town of Newport, if nothing is refused the enemy in that he can find other and better resting places uncovered by defenses, what then is the argument for fortifying the point, other than for the protection of Providence and other points on the bay? The rational answer would seem to be that it may be considered as the outpost for the interests ashore, which can also be protected by inner lines; that is, it forms a powerful link in the extensive scheme of defense devised for the eastern entrance of Long Island Sound.

The entrance to Long Island Sound comes next for consideration, and strategically considered it would seem to be one of the most important points of the Atlantic coastline. The desirability of protecting it by fixed defenses seems so obvious that the only real question in the matter would appear to be whether it is adapted to such treatment,—whether it is feasible to guard the entrance. The engineers assume that such defense is entirely practicable. Being the gate of the most important waterway of the entire coast, it is as well the outpost of New York on its most vulnerable side, and the question of fortifying it adequately involves works at the southern end of the line marking the narrowest parts; intermediate works, and a fortified base at New London. It is probable that the Long Island end from its physical characteristics cannot be fully developed, but in the presence of a fleet and the other supporting defenses it would be well nigh impregnable. In the absence of a fleet, the defenses should certainly be able to hold out for a time, until they could be relieved, and if there be no relief they might as well fall. New London harbor, at the mouth of the Thames,

the engineers also assure us, is capable of a high order of passive defense. It occupies in addition to its position on the defensive line a position relative to the sound analagous to that of Hampton Roads to Chesapeake Bay; that of Key West to the Gulf of Mexico, and to many strong points in foreign countries deemed worthy of the highest treatment. If the line of the entrance be forced, no enemy in his surely disorganized state would venture to leave a hostile naval force behind, sheltered under the defenses of the harbor. He could not leave it behind intact only as the base for an expected fleet. As distinguished from Newport, Block Island, Buzzard's Bay, or other like favorable locations for an enemy, New London gains greatly by being just where it is. The question of refusing any part of Long Island or of the Connecticut shore to an enemy bent upon a coup-de-main directed against the great interests at the bottom of the sound is purely a military one and no fixed defenses can prevent him gaining a foothold. The narrow entrances at the bottom of the sound to the East River are easily susceptible of defense and should be liberally treated.

No other section of our coast except possibly the Florida Keys, is comparable with it in military importance or interest. The holding of Long Island Sound at the two entrances covers the interests of three great states, New York, Connecticut, and northern New Jersey, and in holding the eastern end much will have been done towards the security of the coastwise trade, although that trade can only completely be secured by a naval superiority. It is stated that the commerce annually reaching New York through the Sound equals in value the total commerce entering by the Narrows. The strategic value of the sound to us or an enemy has been elsewhere referred to, and in our wars with Great Britain, the English fleets were fully aware of it and freely availed themselves of the large and commodious harbor offered by Gardiner's Bay. A modern fleet would find it a most advantageous spot for the transfer of supplies, and its simple occupation by such a fleet would disjoint almost the entire coastwise trade, placing the enemy in the most favorable position for naval operations of whatever nature. The proper fortification of the line crossing the entrance, in all that is implied, would involve works on Plum Island, Gull Island, Race Rock, and possibly on Valliant Rock.

Works on Gardiner Point in addition would interdict the only passage into Gardiner's Bay suitable for large vessels; the width of the passage here between Plum Island and Gardiner's Island being but two and one-half miles. The Race has a width of three and one-half miles with Valliant Rock in the centre, and is the only passage suitable to vessels of size. Works on the islands mentioned and the rocks, with submarine mines should deter an enemy from attacking. All the works besides those of New London, can be dispensed with in the sound, except those at the western end. At the entrance by the Narrows, defensive works should be placed at the Hook and Highlands; on the shoals in the lower bay, presumably Romer Shoals; Coney Island, and points to the eastward; on Staten Island on the southeast face; at the Narrows on Staten Island and Long Island, and at points above points which are favorably placed for mortars commanding the entrance. The lower works in covering the lower bay cover the immense interests of northern New Jersey in addition to gaining the great strategic advantage of holding the bay. The suburbs of Brooklyn, however, may be exposed to distant bombardment. Works of the highest order would seem to be demanded in the lower bay, but probably one of the best defenses against the entrance of vessels would be the removal of navigation marks and the judicious use of submarine mines. The works would still be needed, though our estimation of the magnitude may be sensibly diminished. For large strange vessels the navigation of the entrance is sufficiently intricate even now, and if an enemy should not be provided with pilots of the first order, he would be embarrassed in making the entrance. Foreign pilots for New York, however, can be assumed as with the enemy, but confusing marks may still hamper the entrance. Submarine mines and controllable torpedoes should be sufficient to stop him, if properly flanked.

It is interesting to recall the old works as they existed in the War of the Revolution and the War of 1812. In the first war they were placed at the corner of Catherine and Cherry streets, at Coenties Slip; the foot of Broadway, and on the hills bordering the Hudson. The principal works of our late Civil War were at Hell Gate, Castle Garden, Governor's Island and Bedloe's Island, the lower bay being open to whoever wanted it.

The next division of the coast from New York to Hatteras is characterized by few or no places which an enemy would or could make an object of attack, few places offering any facilities to an enemy. With the exception of the Delaware and Chesapeake Bays, there are no openings giving an entrance to vessels of any size. Fixed defenses cannot dispute an entrance to the mouths of either bay, or the occupation by an enemy of their lower sections. It would seem that at some fit point in the Delaware capable of being defended, that the progress of an enemy should stop. If the enemy reaches to Delaware City the interior line of communication is cut. Delaware Bay, we are informed, can be forbidden to an enemy without difficulty. In the Chesapeake conditions are somewhat different, and the question of fortifying no other point has been so warmly discussed as that of fortifying Hampton Roads. The location of the Norfolk Navy Yard is undeniably a superb one, and so far as fortifications at Hampton Roads tend to protect it, they are demanded. The location, while not entirely favorable, is yet such as to tend towards a formidable defense, and on the principle of keeping defenses in advance of the interest they are to cover, the point is well chosen. Because an enemy can turn them and threaten Norfolk by land on either side is no reason, as sometimes urged, why the passage for ships should not be guarded. As covering Norfolk, the works at Hampton Roads are demanded, and for other strategic reasons they are also invaluable. While in existence and covering a possible naval force, no enemy can proceed to execute any operations throughout the extent of Chesapeake Bay and its tributaries without first engaging that force or at least sealing it up and masking it. Harassing attempts can be originated and made upon him from that base, and if he cannot hermetically seal it, his whole action in the bay will be disturbed and perhaps prevented. A vital point in the interior commercial route is also secured by the defenses of Hampton Roads.

Baltimore and Annapolis should be provided with defenses proportioned to the attack—a comparatively light defense, we are assured under the conditions that obtain there, is quite sufficient. Fixed defenses in the Potomac cannot prevent a recurrence of the events of 1814-15. Light defenses, however, can prevent the passage of the only vessels able to use the river.

South of Cape Henry there are few sites favorable for occupation by a floating force. The character of the coast is very much the same throughout its extent to Florida Keys—low and sandy, with many minor breaks leading to the interior line. Outside of nearly every entrance is usually to be found a bar interdicting entrance except to vessels of light or the lightest draft. In the majority of cases light defenses supplementing the naval forces, torpedo-boats and gunboats in the interior waters would be quite sufficient to refuse passage to such an enemy as could attempt it.

Port Royal, admitting large vessels, demands treatment of the highest type, as, lying midway between the Chesapeake and the Straits of Florida, together with fortified points at the Mississippi, it repeats the system of coast fortification in the three strongly placed and fortified points of Venice, Taranto and Spezia, and it is further a naval station to which its strategic position gives great importance, the feature of outlying bases being faithfully repeated.

The vital importance of holding a point or points on our southernmost salient commanding the Straits of Florida, the great highway of commerce, will be appreciated when it is considered what the effect would be upon our commercial and naval movements should such points be abandoned to the enemy. The mere fact of such occupation would paralyze the former, while its effect upon the latter can only be imagined, for consider our fleets deprived of that base so vital to them even during the Spanish War. There can be little doubt that other enterprises undertaken by these fleets would be abandoned and that the recovery of that base would become the main objective of those fleets, thus illustrating the inter-dependence of fleets and seacoast fortifications. If the base under fortifications were able to hold out for a time against hostile attacks until the fleet arrived, the naval action at that point would become of vast importance and one in which the advantage would be with us, whereas with the enemy in possession the reverse would be equally true. Consider further the condition of vessels as to coal efficiency after steaming at speed from our northern ports to the southern waters, if deprived of the ability to replenish the depleted bunkers at friendly bases while the hostile fleet is in the vicinity. In a strategic sense the Florida

Keys are nearer to more strongholds of foreign power and influence in this hemisphere than are any other points upon the mainland, and, thrust far out to the southeast or west, a vast stream of commerce flows unceasingly by them. The situation in both the military and commercial sense but repeats that at Gibraltar, Taranto and The Skaw. The Tortugas in addition look well towards the channel of Yucatan, and it is good that such an important place has been accorded them in the general scheme of fortification. The gulf coast continues the general strategic features of the southern Atlantic coast, at several points permitting the entrance of large vessels, but at other points the defenses should be of the strongest, and able to withstand the attack to which their location and the depth of water may lay them open, while points completely exposed to attack should be neglected.

In general, the character of the gulf coast is not different from that of the section just considered, there not being many breaks in its continuity admitting large vessels, and the feature of outlying bars being equally characteristic of the two sections, it may be safely assumed that the system of coast fortifications applicable to one section of the coast would apply equally to the other.

The Delta of the Mississippi is flanked by sounds and lakes connecting with the stream itself by canals. None of these waters is of suitable depth for occupancy by foreign squadrons, for they are navigable by light-draft vessels only. The modern conditions are such that an attempt at a coup-de-main with New Orleans for an objective could or should be easily repulsed. The former deficiencies in transportation and communication have been entirely removed, and the whole strength of the country could be readily thrown into the defense. It may be assumed that an enemy could readily blockade the passes and might even artificially obstruct the South Pass, assuming the absence of our naval force, but it does not seem likely that an enemy in face of modern defenses would care to repeat the action of Admiral Farragut. Torpedo-boats constituting a river flotilla could operate in the delta under the most favorable circumstances. No other means for preventing the obstruction of the passes is apparent if the command of the gulf is lost to us.

Without dwelling upon the strategic features of the Pacific

coast or of the shores of the Great Lakes, the author cannot dwell too earnestly upon the fact so often insisted upon in these pages, that, in any system of fortifications projected or in course of construction, the question of fortifying this or that point to a greater or lesser extent resolves itself into the strength of the naval attack to which it may be subjected. In other words, it is not purely a question of the strength of attack which can be delivered without reference to what our fleets may be doing in other parts of the world to prevent such an attack, but that it is a question, first, last, and all the time, what are those fleets doing to that end, for without those fleets, the fortifications are useless; hence the pre-eminence which should be accorded to the naval strategy of a nation when any scheme is under consideration involving the defense of coasts. Fortifications do not set fleets free, nor do great fleets remove the need for fortifications, for at certain well-chosen spots there must be fortifications under cover of which those fleets may replenish and refit; and which, in the absence of those fleets, may yet withstand an attack for a time sufficient to permit their relief from the sea. It is unnecessary to recall the use to Cervera of the fortifications of Santiago, but another example occuring during the same war does not appear to have been emphasized to the same extent. The squadron posted in Hampton Roads during the opening days of the war under certain supposable circumstances might have derived the same benefit from fortifications. If threatened by the attack of a superior fleet, which had arrived on the coast in fighting condition, the squadron had been compelled, through need of refitting, to seek a harbor or have been caught at anchor in the harbor, the fortification would have played an important part. When ready, the squadron, inferior or superior, could have met the enemy, with the result that, if not victorious, the enemy's squadron would have been in no condition to have undertaken territorial attacks. Further, it may be asserted that a hostile squadron appearing off our coast with the knowledge that our squadron, though inferior, was intact, and at a well chosen point, would not venture to undertake any operations against any part of our coastline requiring time for its execution.

From Hampton Roads our squadron can relieve any part of the threatened Atlantic seaboard, and with a squadron at Key

West, the entire Atlantic coast is covered. Fortifications cause the necessary pause or delay, for, in attacking them, the ammunition is exhausted even though the attack has not suffered material injury, and in this condition the fleet is in the worst possible condition to support a contest at sea. This use of a defending fleet is what is expressed in the term flanking fleet, and is, without doubt, the use for which the squadron at Hampton Roads was intended, for Cervera would have had but scant opportunity for territorial attacks before the squadron would have challenged him upon the scene, and Cervera being a naval strategist, would not have undertaken such enterprises until our squadron had been disposed of. As a naval strategist, his only possible objective at that time could have been our floating forces, and hence it should be apparent how these squadrons were protecting the great military and commercial ports of the nation though seemingly idle in port. When, later, the Spanish Navy had ceased to be a military factor to be seriously considered, it was open to us, having command of the sea, to undertake any form of territorial conquest which might have been deemed desirable.

The purely naval attack upon a fortress, or the dispositions for the defense of a maritime fortress, subjected to a naval attack scarcely can be classed with any other operation of war, although various comparisons have been instituted, but not generally sufficiently sustained by argument or example, the closest comparison perhaps being to that of a siege in regular order maintained against a land fortress, and in this case the analogy fails in many essentials. It is usually accepted that if siege be adequately laid to any fortress which cannot be relieved, the fortress must fall, the conditions being that the besieger must be able, while constantly assuming the offensive, to deprive the besieged of his communications. Under these circumstances the besieger is constantly gaining in strength, or at least replacing his losses, while the strength of the besieged is being gradually sapped and undermined without power of renewal.

In order to fulfil these conditions in the siege of a maritime stronghold, there is necessary to the fleet an adequate landing force, which, while laying siege to the position, effectually

shutting it in from outside aid, derives its support and sustenance from the fleet, the analogy here being more or less complete. The artillery of the fleet performs the part of the artillery of the siege in keeping down the fire of the besieged, thus restricting the action of the fleet to that of the siege artillery.

The naval history of the Civil War is rich in examples illustrative of this duty of vessels, frequently the fire of the fleet in combination with the siege artillery of the military forces preparing the way for the assault.

No further comparison of the action of ships with that of artillery in the field can be drawn from the simple consideration of the fact that the target of field artillery is only in part the opposing artillery, while the target of ships in action against fortifications (proper fortifications) should be almost entirely the opposing guns, for, as before stated, it is true that every shot that imbeds itself in properly constructed earthworks, that falls short or over the crest, or that fails to injure a gun or carriage, is lost except for the moral effect produced.

In endeavoring to arrive at some deductions that may be applicable to the class of operations under consideration, it is natural and proper to seek for analogies, which may tend to elucidate the principles which should guide the attack or the defense in such operations. When the attacking squadron has arrived before a port with the intention of operating offensively, strategy has given way to tactics, and it may be that in the present universal state of uncertainty concerning the tactical application of the highly developed modern weapons, that changes of importance are required in our conceptions as to that application. Military students have arrived at a gratifying concensus of opinion that the principles of military and naval strategy are identical as well as immutable. There is, however, no such consensus of opinion when the subject of tactics is under consideration, and for this reason, the assertion is ventured here, with hesitation, that the differences may be more relative and less radical than generally supposed, and that tactical principles have not changed to the extent sometimes insisted upon, and certainly not to the extent that weapons have changed or improved. Angles of presentment will be different, ranges will be widely different, and the targets offered

by ships as well as fortifications have undergone radical changes, but before a fight takes place the ships as formerly have got to be brought to their fighting ranges, and when there they must be maneuvered—the motive power of steam permitting these operations to be made with far greater certainty and precision than formerly, but it cannot be positively stated that the tactics in the attack and defense have been radically changed thereby. The sailing fleet had to wait for its opportunity, but when the opportunity arrived, it had to be handled with the same tactical ends in view. The greater tactical differences will perhaps be found in the guns and targets, but formerly the target for guns on shore was the motive power represented by the sails and rigging, with the crews at the guns. To-day the crew and guns, the flotability, and the motive power are still the targets, though the conditions under which they are to be attacked are totally different.

In the case of a fleet unaided beginning operations against a maritime position, it will be found that its front of operations will in most cases be restricted if the defense has done its duty. The character of the weapons will determine the varying distances covered by fire, but it will be apparent that a fortified port, as an army in line of battle, will have but the three zones of operations, the right, the centre, and the left. The geographical features of the line of defense will generally determine the weakest point of the three and the relative strength and importance of each; the ordinary form of many harbors offering an angle, or a curve, re-entrant as regards the shore, will hardly furnish a doubt but that the centre is the strongest, and the great majority of the fortifications will command the area in its front, which is but the case of the front of an army in such a line.

An attack in strength upon an extremity of the line of defense, enveloping it in a concentrated fire, might neutralize the advantages of the defense in some degree, depriving it of its cross fire, and securing for the attack what advantages could be obtained from the use of enfilading fire; at any rate, the fleet concentrates its strength upon the part of the line which the defense is less likely to be able to support; as at Charleston we see the ironclad fleet finally learning that lesson, whatever might have been the case as regards the ability of the fleet to

have gone on to the city at any time, when it settled down to the silencing or reduction of Wagner it was doing the right thing, tactically considered, and when Dupont subdued the forts at Port Royal he concentrated his fire first upon one, then upon the other.

When the line of defense presents the rare case of a salient to the sea, it may be judicious for the fleet to disperse over only a portion of the defense perhaps, thus masking the remainder while maintaining a cross fire over the works, obtaining what advantages there may be from reverse fire; of course flanks cannot be driven in, nor the centre broken in the sense that the flanks of an army may be driven in and thrown into confusion, but the same results may be produced.

Having dwelt to some extent upon the tactical limits of weapons and accessories, and their use afloat and ashore, it may not be amiss to examine somewhat closely the problem confronting an admiral under instructions to make an attack in force upon a fortified port of the first rank, bearing in mind that, while the whole system of coast defense to whatever extent it is carried is based solely upon the probable nature and extent of an attack, and that attack must be modified and controlled by the state of preparation of the defense. The position of the defense will be nearly as follows: the guns mounted will perhaps be equal in numbers and power to those of the attack, and the direction of that attack being closely a matter of dividers in the hands of the defense, the guns will be so placed, governed by the character of the land, as to maintain a continuous fire over the entire water approaches from the extremest effective range to the line marking the draft of water beyond which the ships may not advance. A skilful arrangement of the batteries will enable this concentrated fire to be maintained with the greatest number of guns, and it will be noticed that the initial fire of the defense will be that from the heaviest guns and from the mortars; and as the arc of fire narrows, the volume will increase as the range of the lighter quicker fire guns becomes effective. In some harbors a concentration of fire will be possible over the entire front of operations of the attack, while in others, there will be centres of concentration owing to the irregular configuration of the coastline in which centres various groups of batteries will offer mutual support.

All the possible combinations of fire will be studied and prepared beforehand it is to be hoped over the whole known ground; the standard of perfection being the greatest possible volume and intensity of fire over the zone of approach. So far as compatible with this standard, the guns themselves will be as widely dispersed laterally and in elevation as possible,—every feature of the terrain tending to invisibility will be utilized. Engineers charged with the construction of seacoast defenses should make a part of their study from the sea, so that they may know that the works are concealed. Mortars will remain entirely concealed, and at a distance of 2000 yards it should be next to impossible with a powerful glass even to see a gun properly mounted under the ordinary atmospheric conditions that obtain in seaports. The supply of ammunition of the defense may be assumed to be practically inexhaustible; and it scarcely can be expected that the bitter lessons of the past in the matter of the danger following its exposure will be ignored. Attempts have been made to assign a primary position to the submarine system of defense of a fortified port, but, important as it is, it must rank second to the gun defense, from the simple consideration of the fact that unless mines are covered and flanked by guns they can readily and easily be removed, as was repeatedly done during the Civil War, and is to-day accomplished in the annual maneuvers. A question that suggests itself at once regarding obstructions of all kinds and concerning their rôle of defense is, is it desirable to forbid the attacking fleet approaching to fighting ranges, or, is the defense strong enough to desire a trial of strength? While it may not be contemplated that a fleet will entangle itself in a mesh of obstructions, it is possible that the attempts at countermining may have had only partial success, or the damage done may have been repaired; or once in the mine field, the injury or alarm of one ship, the moral effect especially in a narrow channel, may give the defense the opportunity it desires. This would indicate that the mine field should cover the locus of the effective fire of the defense, but if delay is vital to the defense, the mine system should be more advanced and extended. Should the harbor possess several channels of approach, all but one would probably have been strewn with contact mines of the most effective type, which are at the same time the most dangerous. One channel preserved

for friendly use to the last may have been provided with the electrical contact mines, acting upon contact or not, at the will of the observer, though in presence of a hostile fleet the more effective mine may have been substituted; all this upon a prearranged plan. The channels will be further obstructed; delay to the fleet, at any rate under fire, is vital to the defense. All questions of exit or entrance other than to those of the mobile defense or to friendly vessels should now be waived. For the proper operations of mine fields, a system of position finding is essential, and would be thoroughly worked out, and at the present stage of range and position finding for the proper service of guns on shore, it may be assumed that the gunners will be furnished momentarily with all the data needful for the accurate pointing and ranging of their guns, if indeed the guns are not pointed by the mechanism of the finder itself.

The searchlights will be so placed and so handled as to illuminate at the proper time and in the proper way points needful to enable the gunners to lay their guns without the embarassment that attends the improper use of those valuable auxiliaries, and they should be arranged in positions separate from the batteries and independent altogether of them, while others should cover the mine field, positions near the water being the best. The source of the beam will naturally be a target for machine gun fire or quick fire, and there is no reason why the batteries should be subject to that fire with them; besides, when near the guns, the aim is deranged through many causes—reflections on the sights, brilliancy of the beam and others—and further, positions away from the light are better for observers as well as for the gunners. Experiment has amply proven that positions for the lights are better located away from the guns, the reason being the interference in the beam of light of particles of dust, and the presence of smoke or mist, with the consequent repeated reflections caused by such particles. An observer near the source of light has all these reflections against him, while if the observer is above the level of the lights, the area illuminated is more under his observation. The chances of the light being hit are extremely small, for in the face of the brilliant illumination, neighboring objects are relatively more indistinct, and an accurate estimation of distances is out of the question. At point-blank ranges

only is a successful hit on a searchlight more than a mere chance, and if in addition the light can be shifted occasionally, or, as has been suggested, if the light be shielded entirely, throwing its rays upon a comparatively cheap reflecting surface, the problem of protection to the lights is solved.

Experiments carried out in England between the years 1884 and 1888 go to show most conclusively that the searchlight is most valuable to the defense, especially when its beam is thrown over a water surface. It was found impossible either to get the range of a searchlight or to give aim properly when the sights were in the sector of the beam; this was the case both when small arms and machine guns were used. From the nature of things, the flanking defenses may be well advanced in front of the main defense, and provision made against a party landed to destroy them which will be best effected by rifle and machine gun fire over any ground practicable for the landing or approach of such parties. If the countermining flotilla has within its numbers a vessel or vessels provided with searchlights, a good tactical use of the light in that case would be to throw its rays directly into the eyes of the gunners on shore; the vessel using the light in such a way would be a comparatively poor target, and would thus furnish a valuable diversion favoring the object of attack.

The vedette duties for a seaport can be performed perfectly by torpedo-boats unless steam tugs and yachts are deemed available for that purpose; there seems no need for an especial type for the performance of this duty, the importance of which is perhaps on the increase. The torpedoes, other than mines, controllable or automobile, operated from shore stations will be in a state of readiness for use at the proper time; and so far as organization and system can go there should be no misdirection in their use. Lastly, to complete this resumé of the condition of a fortified port, it is fair to assume that there is free and easy communication between all its parts and a perfect community of interest, each element developing its efficiency to the utmost, while a harmony is maintained throughout the whole, the key to all being organization.

Before bringing the forces to the test of battle, it is well to understand the status of the attacking fleet as it may be constituted. On the original assumption upon which the system

of fortification has been based, the attack will bring to bear in armor-clad vessels, an armament not inferior to that on shore, equally protected over limited areas, and a large secondary armament. The attack will also include a number of cruisers of small protection but of large secondary battery and strength, besides a numerous flotilla of the most efficient seagoing torpedo vessels, as well as boats of a smaller type transported in depot or other ships. There will also be repair ships, ammunition transports, supply ships of all kinds; and very likely there will accompany the fleet, vessels of an especial type prepared for the particular operation in view. The batteries of the fleets will possibly number amongst their weapons guns for curved and high angle fire, and for the use of high explosives, unless, indeed, high explosives and smokeless powder do not form the greater part of the ammunition of the fleet. Just as the siege of a great land fortress is not carried on by an army constituted for field operations, but is a matter requiring especial preparation and appurtenances, so will the naval siege of a maritime fortress only be attempted with especial appliances, and such a fleet will not be brought complete into the presence of coast defense. A secure station will have been established, and only the effective fighting part of the fleet will proceed at first to the active work of the siege.

Such being the constitution of the defense and the attack, the relative limitations and advantages of each should now be considered, and in this connection analysis may prove the safest guide. The defense, as should be the case in all military operations, has been prepared deliberately in advance to the best advantage upon the field of battle, the direction of the attack having been restricted and having been foreseen. To offset this advantage, the defense has no mobility, no power other than in the possession of especial vessels to assume the offensive at appropriate times. It is not necessary to compare the relative gun efficiency of the attack and defense, as to which has the advantage, the fixed gun firing at a moving target, or the moving gun whose target is fixed—the range and position finder and smokeless powder have settled that question in favor of the defense. It may be urged against this opinion that the range and position finder has found its application on board ship, but thus far its base line is limited; its efficiency is

impaired on certain bearings, and the slightest unsteadiness of the ship will preclude the laying of guns otherwise than by direct sight; it is further considered unreliable on board ship from the rupturing of its connections by shock. On shore the choice of base lines is almost unfettered; the steady guns may be laid in various ways, and, in the case of mortars, nothing whatever is gained by a direct visual pointing. The range and position finders on board ship cannot avoid the shock, while those on shore can be placed so as to be but slightly, if at all, embarrassed by it. It has been said that a tendency existed to underrate the advantage possessed by the ship in its mobility, but if it is considered that both the fire from the ship and from the shore are affected in the same degree by that mobility, and that every hit on the ship tells, while only hits on the gun or its carriage or in the magazines (which, as before stated, should be impossible) are fatal to properly installed shore guns, it may perhaps be admitted that fixed guns have the advantage.

The defense should be enabled, so far as the ammunition is concerned, to sustain an unlimited siege, and, while the attacking fleet can keep up its supplies by sea, the advantage in this respect would seem to rest with the defense. Should the attack be undertaken while the defense had at some other point a floating force yet intact and unmasked, the attack would be liable to the loss of its supply vessels en route, another illustration of the influence of a fleet in protecting a coast, for under such circumstances the attack could not be delivered. At close range the defense may possess a certain mobility if comparatively heavy guns can be transported from point to point, thereby enabling an unexpected concentration of fire upon the unarmored portions of vessels.*

No other advantages possessed by the defense seem specially noteworthy, unless reference is made to the delaying power in its hands in the shape of obstructions perhaps renewed from time to time. The attack has the choice of the time and manner in which to give the assault, and also is not ignorant of the

*It is stated that the Confederates, at least in the Ogeechee River works, shifted the position of their guns with good results when attacked at different times by monitors.

field of battle, having exhausted every means of obtaining information, through its intelligence staff, through capture, and through reconnaissances. It can deliver the assault as it pleases, while its guns can support or concentrate their fire in all possible combinations, limited only by the water approach. If the attack fails or seems hopeless, it can withdraw; while on the other hand, if it succeeds and the defense is silenced or destroyed, the attack by ships must call in another force to profit to the full from the victory. If the object be other than mere destruction, this is as well a limitation placed upon the defense, the only result it can hope to draw from success being the repulse of the attack with such incidental losses as the attack may suffer. The defense must fight when and how the attack pleases, and can reap no further advantage from success than the maintenance of its integrity, and must remain in position subject to further attack, an attack perhaps delivered upon new lines.

Having thus considered the constitution of the attack and the defense, their limitations and relative advantages and disadvantages, it will next be proper to examine the objects the attack may have in view, as influencing the mode or manner of attack. In this examination the defense has little standing, for it has perforce covered all contingencies as far as lay within its power, but it cannot be assumed that the attack intelligently delivered will proceed as though there were no object other than a test of strength. The defense, we will say, will cover an arsenal, a naval arsenal; and, as is usually the case, the location of an arsenal is a pivotal point of commerce and a decisive strategic point of the littoral, and also a great city. It may be that an inferior fleet and improvised coast-defense vessels are sheltered within the works, a not unusual condition in the light of experience. The political character of the war will be a large factor in determining the objective, as will also the opinion the attack holds of the defense affect the manner of attacking that objective.

The objective may be the destruction of the arsenal and shipping, as was the case at several places during the Civil War. If this cannot be attained by distant bombardment, the fortifications must be silenced and passed; the same being true if the objective is to obtain a money ransom from the city, under

threat of bombardment, and a great deal is heard of this objective nowadays.

It may well be stated that the fears of our own people on this point are excessive. To reach the outskirts of Brooklyn—the only points than can be reached by shell fire from the sea—vessels drawing 20 feet of water and over can approach in safety only to within about six miles, and only then by placing themselves in a narrow, dangerous pocket. If under fire from concealed gun and mortar batteries, their practice with the extreme elevation demanded should not be very satisfactory, and certainly need not cause panic among the population. There is also, as we have seen, a trend of thought, more or less expert, toward a naval warfare of destruction both of public and of private property. If there be truth in the views before quoted, views which receive a certain amount of support, such a warfare may be looked for. If the vessels of the inferior naval force—and it is acknowledged there are grounds for the belief in recent wars—are going to shut themselves up under the guns of fortified ports, there will be little for the superior navy to do after dispositions have been made for a war on commerce, if he is not to attack the enemy in his ports in case he cannot draw him out. The shutting up of the enemy will hardly be sufficient to the attacking fleet or to the people behind it, apart from the fact that the lapse of time under certain conditions tells more against the attack than the defense.

It may be assumed that few considerations will deter hostile vessels from demanding an indemnity from towns and cities liable to bombardment, and this cannot be prevented, and the reduction of such places may be exceptionally a military necessity, perhaps to break up a focus of opposition. Bombardments of the strong points of very inferior powers are produc-

*It is stated that in the instructions issued to Commandants of English Fortresses some years back directing them to prepare complete schemes for the defense of the places under their jurisdiction, that the effect of bombardment was in nearly every case more moral than actual upon the public, and that if good arrangements were made for putting out fires, arrangements which have been organized in these stations as far as possible in times of peace, no place need submit to pay forced contributions simply because it is threatened with bombardment at long range.

tive at times of important results even where the power of retaliation is absent.*

Concerning the point whether vessels should anchor or not in engaging fortifications, Captain Goodrich says in reference to the Alexandria bombardment: "Hammering away was very skilfull, and, in the end, was tolerably fortunate, but it is certain that the length of the action, while abundantly foreshadowed in Admiral Seymour's order of the battle, was a disappointment to those who expected short work to be made of the Egyptians, while it drained the stock of ammunition to a dangerously low ebb. The outside squadron having tried both modes of attack, under way and at anchor, definitely solved one important problem: There remains no possible doubt that ships engaging forts not superior to them in force gain more in accuracy of fire by anchoring than in safety by keeping under way."

If the action is carried on with the ships under way, they may fire from fixed points, and they need be under way only in case the high angle fire from shore is accurate enough to make their danger from that source very real; and torpedo flotillas may compel the attacking fleet to remain under way, and no doubt will do so, if the past be any guide. The defense will hardly make use of torpedo-boats by daylight as an offensive return to such an attack, although attempts may be made, but at night they will assuredly endeavor to find and attack the squadron. The answer of the attack would be the vigilant picket system, rapid-fire and machine guns, and a counter offensive with torpedo-boats, while its mobility would be the best defense.

It may form part of the programme of the attack to occupy the position assaulted as the base; the destruction of the material interests of the place then would not be politic. At Port Royal it was necessary to overcome the fortifications at the entrance, the object was the undisturbed occupation of the Roads as a base. It may be necessary to break up the commerce of the place, and if the blockade is not sufficient, the overcoming of its defenses and its occupation will be incumbent

* It is said that in 1878 the Russian Admirals in the East had instructions to demand large sums of money from Sydney and Melbourne under threat of bombardment with some hours notice.

upon the attack. While the blockade at Charleston and the Cape Fear River became remarkably effective, it was deemed advisable to make prodigious efforts for the reduction and possession of their defenses. The objective of the action in the Mississippi was New Orleans, and the severing of the Confederacy a part of the anaconda policy practiced towards the South. All the fortifications on the river did not materially aid the Confederacy in maintaining its communications, the forts were only passed, falling by their own weight when the fleet had run by them, thus severing their communications and opening the river. At Mobile the defending fleet having been beaten and the fortifications overcome, the blockade was absolute; the city and shipping did not suffer. These examples only emphasize the fact that between a fleet and fortifications, there will not be a blind struggle, but a carefully planned and executed exhibition of tactical skill, having constantly in view on the side of the attack a well-defined objective, to the frustration of which all the energies of the defense will be bent.

The objectives, then, which an attacking fleet might have in view may be as follows:

1. Complete conquest and occupation, which, however, may be only temporary.

2. The destruction of the defenses and war material, or of either.

3. Bombardment of cities before or after the defenses have been silenced, perhaps following a demand for ransom.

4. The destruction of shipping.

5. The results to be obtained from raids.

A reconnaissance will precede all attacks of magnitude of whatever nation; it will be made by fast cruisers or torpedo cruisers, and should have for its object the locating so far as possible, and estimating the nature and strength of all the defensive resources. This service will require a large amount of skill, demanding for its performance a fine military insight. Soundings should, in cases, be taken and sketches made, all changes in the aids to navigation noted; and it would be one of the many duties of this party to make captures of boats or fishermen, landing if necessary for the purpose. These rapid cruisers fulfil the purpose of cavalry in this respect. A reconnaissance further should also have for its objects the selecting

of landmarks or constructions that might serve in ranging the guns, or as marking the positions to be reached by gun fire. The examination should also have for one of its objects the searching out of the nests of torpedo boats along the coast, and should be made in force and numbers sufficient to break them up and destroy or capture boats wherever found. Other objects to be obtained will suggest themselves, such as laying buoys for ranges, and if deemed necessary, drawing the fire of the batteries. The reply of the defense lies in the perfection of its signalling system, picket boats, and the facility and safety with which the torpedo-boats can be moved from point to point, ready to avail of opportunities to attack.

One precaution to be observed by the defense is so obvious in time of war that it hardly needs notice, that is, to remove from the coast or from the vicinity liable to attack by cruisers or raiders, anything that can in any way benefit them—live stock, rolling stock, stores of all kinds—and all pilots and persons competent for pilot work should be placed under surveillance. The reconnoitering vessels besides their duties as outlined pertaining to the reconnaissances of selected ports, would have the still more vital duties of searching out the defense fleets. The smaller, the more numerous and more rapid the vessels, the more effectively could they perform all their multifarious duties. Matters of importance will require to be communicated at once to the fleet, and yet touch should not be lost with the enemy. The mine fields will first demand attention by the attack, if they are so placed as to interfere with the fleet in properly posting itself to begin the attack. Being perfectly under the command of rapid-fire and machine guns, riflemen, and even old-type guns using shrapnel and canister, as well as many of the guns of the main defenses, no efforts will be made at countermining by daylight other than such as may be made by projecting explosives into the mine field and by a fire maintained on the guns of the flanking defense. Night furnishes the opportunity for countermining. The defense will be with searchlights, torpedo-boats, and vedettes or picket boats, and the flanking guns; the vedettes and torpedo-boats to give the alarm and to engage if able. The searchlights should cover a well-defined line in advance of the obstructions, or both in advance and in rear. It does not seem proper

that they should be continually in use. They would but mark the position of the mines for a wary enemy able to draw deductions. They may come into use upon the alarm from the vedettes, or they may be automatically put in action by the attacking or countermining parties.

It has also been proposed that a discharge from the flanking guns over the line might be effected in the same manner; this would seem to be an unnecessary complication apart from the consideration of the width to be covered by such a discharge. Boat torpedoes in advance of the fixed obstructions, or fixed to them, are efficient weapons for the defense.

In the laying of countermines and the throwing of explosives into the mine field, advantage will be taken of the shadows on the water under the land for the concealment of operations. A point vital to both the attack and defense is a simple and effective system for the recognition of friendly vessels, large and small, which will not betray their position to the enemy. Under a proper system combining mines, rapid-fire guns, search-lights, and mobile defenses, countermining promises to be a very desperate business, and such a system will render cutting out expeditions next to impossible, while the attack may be driven to attempts by land against the flanking defenses of the mines, the guns, lights and firing stations.

Should the mine system be restricted to a point or position where the defense is able to concentrate an overwhelming fire upon the attack, it may be that the attack can proceed to take position for overcoming the less supported works and the flanking defenses, intending to operate later against the mine field, or both operations may proceed simultaneously; or the fleet attack by day, the countermining by night. This latter was the position at Charleston, but serious countermining seems to have been omitted. It has been suggested that, in addition to replacing mines destroyed as rapidly as may be possible, the defense should undertake to mine by night the position occupied by the fleet by day. That position, however, will be patrolled by the torpedo craft and vedettes of the attack, and such an attempt would partake of the nature of a folorn hope.

The torpedo flotilla of the defense set apart for offensive action against the fleet would search out the vessels during the

night; there should be no rest for the attacking fleet, no anchoring. The operation of coaling or receiving other supplies from transports would furnish an opportunity that should not be lost. For its own protection against the torpedo-boats the attack has nets, which so far seem liable to be a source of danger and embarrassment rather than of protection; but better still, its own vedettes, and its mobility which enables it to conceal its whereabouts. While it is possible that opportunities may arise during the main action for the torpedo-boats under cover of smoke to attack the vessels, it seems a desperate service. No chance should be neglected to disturb the attack in its base, the neighborhood of a few torpedo-boats belonging to the defense would be source of serious concern to the attack, compelling the attack to take every possible precaution with the result of greatly exhausting and hampering him in all his preparatory operations. The very best protection the attack can have against torpedo-boats is to guard by torpedo vessels and vedettes the outlets used by the boats of the defense, and to fight them in kind, reserving some for service near the rendezvous of the fleet itself—a simple application of a broad strategic principle.

In an open harbor in crescent form, the batteries being at intervals along the shore, a fleet if possessing an overwhelming gun strength might operate along the entire line, vessels in accordance with their power being told off for the purpose of occupying the attention of the individual works. The fleet, not in such force, would do better if the destruction of the batteries was desired, by concentrating its fire upon the shore batteries in succession. Some vessels might be employed in occupying batteries that might furnish a cross fire. There is apparently a tendency in artillery contests to respond to the fire directed upon one or the other party, and a few ships drawing the fire of such batteries dangerously placed would render good assistance. It seems, however, that the best attack to be made upon a line of batteries in crescent form would be upon the flanking batteries at one end; others would be raked, and the batteries at the other end probably would not be able to use their guns effectively.

As the tactics best suited to individual vessels in action with coast defenses should be determined by the balancing of their

qualities, such ships as have their principal or main battery assembled in turrets at either end or at both ends covered with heavy armor, and are comparatively deficient in broadside armor, would undoubtedly be in their most favorable position for defense or immunity from damage from horizontal fire when end on. That position, however, is the worst as regards vertical fire, and such a vessel can bring the greatest number of guns to bear by assuming a bow and quarter position to the object of her attack, that is, all of her main battery and half her secondary battery, while exposing her sides only to oblique hits. But it is extremely unlikely that in making the attack either from anchor or under way that heavy vessels will be able continuously either to choose or hold their most favorable positions. The current and wind may at times favor them, but if in motion in contracted waters they are sure to be thrown out; the effort, however, will be made.

If the main attack is not to be made at extreme ranges, there will be a period of time when the vessels are assuming their position that their fire will be restricted owing to the maneuvering to get into position, during which time they will be under fire of the defense; this opportunity will not be neglected by the defense. In the accounts of sieges in other days, in many cases, as before noted, the attacking vessels were allowed to take their positions, moor, and bring their broadsides to bear, unmolested.

The problem of the attack and defense of a perfectly open harbor is not very interesting, especially, as is generally the case, if the defenses lie close to the interests to be covered. Such a harbor would be undesirable as a base for naval operations owing to the difficulty in securing the anchorage. The interest could be destroyed without engaging the batteries, and if they should be engaged, it would require to be at such close ranges in order to be effective that the fleet would be in a very dangerous position. Such a place, moreover, would be somewhat vulnerable to a coup-de-main. Its sea defense, while very defective, would perhaps be deterrent from all considerations.

Harbors are of all kinds and descriptions, but so far as the tactics involved in their attack is concerned, they divide themselves into but few groups: perfectly open harbors; the kind where the harbor forms a longer or shorter pocket in the shore

line susceptible of defense throughout its extent; and the kind with an entrance susceptible of defense, which defense once passed, an open harbor with a stretch of water lies beyond. There are many variations, but these three types cover the majority of cases. The objectives behind the defense vary, but to get at them in these last two cases, whatever they may be, the line of defense must be passed or thrown down. Nature or art may render the attack easier or more difficult, as the case may be, but it is a difference in degree only. The last case covers that of a deep river, or the entrance to a large bay or an estuary. The second case covers such harbors as Sebastopol, Port Royal or Portland for example; Key West in reality, though it would seem to be a case apart. In the first case, that of open harbors, submarine mines and other obstructions are inapplicable generally, because of the width of the front of operations and the depth of water.

The Civil War established an axiom for all the world, that without obstructions fixed defenses could be passed. Calculations to-day go to show that, notwithstanding the improved accuracy and rapidity of fire, vessels may still slip by defenses unprovided with obstructions, but if the batteries are judiciously placed relative to the channel the risks may be made very great. It may be said with safety that proper obstructions will not permit their being charged at speed, nor will the expedient of sending ahead useless ships prevail where the mines can be exploded at will. If it becomes necessary to force an entrance, the mines must be exploded or removed, and then the case is simply one of running by before they are replaced. If the defenses can be attacked without or beyond danger from the mines, the only tactical matter to be regarded is to so attack the defenses if possible as to neutralize a portion of their fire. If the defense can be overcome in that manner or effectually silenced, the removal of the obstructions becomes a matter of routine; the mines and the guns in this sense appearing as coördinate and supplementary features.

The case of the narrow deep harbor, perhaps characterized by an intricate channel, with its interests at a safe distance from the entrance, its entrance obstructed and the gun defenses supporting each other throughout, offers an ideal of harbor defenses. The attack upon such a position by vessels is justly

regarded as desperate, if not hopeless, and there is little likelihood that it will be attempted in the present stage of naval development. Kiel is such a harbor, as also is Brest, or Santiago de Cuba. If it must be attempted, the attacking squadron must sit down to the task of countermining, but such a place offers the readiest opportunities for keeping the mines in place. The defenses at the entrance must be constantly assailed, for their reduction will facilitate the countermining. If both are successful, the entrance has still to be forced under a concentrated and converging fire growing constantly more intense. No tactical combinations are possible, the vessels must enter in column. The leading vessels must bear the brunt of the effort—the rôle of the leader in column always—interior mines and controlled torpedoes may still require to be dealt with, and torpedo-boats at this stage surely. No, a squadron will not make such an attack; but if it does, there is no other way. If the defenses are concentrated about the entrance, the attack is simpler, but must be proceeded with in the same manner. The ammunition will run out, coal become exhausted, repairs will be required, and vessels will be passing to and from the base, and such opportunities will not be neglected by the defense.

A harbor with the entrance opening into a bay, and with the defenses grouped at the entrance—the entrance being narrow and commanded from both sides—may require to be forced in the same manner as above described. Otherwise it may be possible to concentrate all the powers of attack first upon the defenses of one side by passing in, after the removal of the obstructions, close to that side, or by concentration upon the defenses of one side from the outside. It is always well to have in mind that the defenses cannot be perfect, and from the nature of the ground the engineer may have been obliged to leave a weak point, which should always be looked for when the defenses seem the most perfect. With regard to the nature of the ammunition to be used, armor-piercing shell would seem to be thrown away against works other than turrets or iron-faced works; the guns, detachments and magazines being the targets, common shell and shrapnel appear to be the projectiles promising the best results. Common shell, shrapnel, and perhaps canister or case shot, though its efficiency is doubtful, will be used from the rapid-fire armament; the guns, embrasures

and pits should be sought out, and if the magazines are known, they should receive attention. Observation stations of whatever character should be looked for and attacked. Ships should not be diverted from the objects of their attack, unless a counter-attack requires serious attention.

The subject of the attack, perhaps more especially than the defense of a strongly fortified maritime position, is one that has not been very seriously approached, and it is almost a certainty that the development in war material has still further strengthened the hands of the defense. The very fact that modern progress has compelled the thrusting of coast defenses well to the front is an advantage to the defense in removing the actual struggle further from the interests covered. In the navy, a great deal of the progress is perhaps groping in the dark, while many of the elements which go to make a successful defense are subject to somewhat rigid treatment. Notwithstanding the fact that navies exhibit a marked tendency towards a higher development, vessels constantly appear which in their conception may be called ultra modern; while coast defenses rarely, even beginning with an initial stage of high development, appear to keep up with the times. It is thus possible that, with the exception of large selected harbors, the distribution of advantages may leave the attack in the lead in actual, if not in theoretical, warfare.

It remains only to speak of raids; the forms which they may take are so different and the objects sought so various that there is little definite to be said about them. The principal danger to raiders will lie from the sea. Their object must be obtained through evasion; skill, nerve and watchfulness in the future will be the qualities required, as in the past. Fortifications, except of the lightest character, will not be encountered; the objects will be the acquiring of information, the destruction of the enemy's war material, or the securing of supplies for one's self; coast railroads should suffer, land and ocean telegraps as well; signal stations should be an especial object. The execution of a raid presupposes an insufficient force on the part of the raiders to encounter any but the slightest opposition, and it should be carried into execution with the greatest secrecy and suddenness, upon unsuspecting points. Raids may embarrass the mobilization of troops; they will certainly acquire

valuable information, and all the duties of reconnaissance will as well become their own.

War blockades may perhaps be referred to. Apart from masking and the shutting up an enemy, they may be maintained with the object of shutting an enemy out. In either case—without reference to masking, which is not blockade—the blockader is the superior and should desire a contact with the blockaded. Only the military blockade of military forces is referred to. It may be that the attempt will be made to blockade the whole coast, or only a part of it, or perhaps only one or two parts, but the tactics of the blockaded and the blockader will not be different in any case. In the first place it may be assumed that a complete steam blockade of steam vessels may not be absolutely maintained, either as regards ingress or egress. The condition of the vessels of the blockaded squadron themselves should be superior, and probably the morale of the officers and crews should be better, they not being worn out with watching and constant alertness; the strain upon them is great for a short time, while it is tremendous on the blockader always. Steam permits the blockaded, where there is more than one channel, to take either. In sailing days, probably but one entrance required guarding by the blockader, depending upon the prevailing direction of the wind.

The probable character of blockading fleets is a very good indication of what the proper tactics for them to follow should be. It is a safe assumption that blockading fleets constituted in the immediate future will consist of battleships, cruisers (scouts), gunboats, torpedo cruisers and vedettes; five types perhaps, but it would simplify matters to group them in three divisions, the third comprising cruisers less than 2000 tons, as, though the variation in types of less tonnage may be great, the duties they will be called upon to perform will not essentially be different, not so different as to warrant complicating the question by multiplying the number of general types. If we look first at the question from the point of view of the constitution of the blockading force, it will be apparent that the tactics will be or should be the same in both cases, the blockade inward or the blockade outward. The simple difference will be in the direction in which the front is presented, whether to seaward or to landward. As near as we know at present of

what will be the tactics of an expectant fleet in the open sea, there is essentially no difference between that and the tactics of a blockading fleet. In looking for or awaiting an enemy, the battleships are not thrown to the front. The scouts and vedetts would thus be deprived of any particular duties, and the line of battle would be subject to torpedo and ramming attacks without warning.

A blockade cannot be efficient unless it is maintained close into the port blockaded, whether the operation be masking or blockading. Light-draft, swift vessels fitted to cope with the efforts certain to be made to break the blockade by torpedo-boats and cruisers would seem to be the class upon which reliance must be placed for the inside work. With the scouts forming a second line and maintaining communication with the line of battle, it would appear that each part is fulfilling its duty to the utmost; the fighting line is relieved as far as possible from the designs of the mosquito attack, its strength is the better concealed, and the detachments to the base and the recruits from the base are somewhat unknown to the enemy. The port is hemmed in by a light mobile force and communications are kept up as rapidly as possible. For the blockaded fleet to escape undetected from such a guard can hardly be expected. A diversion must be created, a feint made, under cover of which the escape may be feasible. Mines in case of close blockade, amounting to shutting up the vessels, may play a prominent part. If the blockade front is seaward, the dispositions will naturally be somewhat different. The battleships should not be left unguarded to the rear or shorewards from torpedo attack. The scouts would then form the advanced line, the smaller craft performing their duties on the second line to seaward and to landward of the fleet. Front may sometimes have to be given both ways, in which case the number of scouts will have to be great, and the task will be difficult. It is not apprehended that the conditions governing a commercial blockade will be widely different.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

# TORPEDO-BOAT ORGANIZATION AND SERVICE: ATLANTIC COAST OF THE UNITED STATES.*

By COMMANDER W. W. KIMBALL, U. S. Navy.

## DESIDERATA.

1. To organize the service in such a way as to render possible the effective mobilization of the entire flotilla for war or practice in the shortest time.

2. To have at all times available a certain small number of trained torpedo-boat officers and men so organized as to furnish nuclei of crews for the whole flotilla, and thus guard against the necessity for manning boats with crews in which there would be no one with any torpedo-boat training.

3. To organize the trained men in such a way as to make the mobilization of the flotilla as inexpensive as possible.

4. To have the training in torpedo-boat service constantly going on and a consequent regular flow of torpedo-boat officers into general service.

5. To include in torpedo-boat training the investigation of our coast and practical studies of it as regards torpedo-boat operations.

## GENERAL CONDITION OF THE PRESENT FLOTILLA IN CONNECTION WITH ITS DUTY IN THE MOBILE DEFENSES OF THE ATLANTIC COAST.

There are thirty boats built and building upon this coast, and among the thirty boats, seventeen different kinds are found, with differences ranging from that of a ratio of 6 to 1 in displacement to those of small differences in dimensions and

* Part of a lecture delivered at the Naval War College, July 25, 1901.

considerable differences in details of motive power, speed, endurance and maneuvering qualities.

Four is the greatest number of boats that can be considered sufficiently alike to apply to them the principle that men trained in one boat are competent to handle all other boats of that particular group, and therefore the method of training for groups which would be most satisfactory if our boats had been built in groups, can have only a partial application in the existing flotilla.

The boats mobilized for war must be available for use in the mobile defenses of the coast anywhere from Eastport to Galveston, concentrated in a particular locality or stationed in groups for the defense of several ports. It is now the practice of the Department to lay up boats not in commission at several naval stations, a few here and a few there, and for convenience as well as for possible strategic reasons this practice may continue; or the policy of laying boats up at some one general lay-up station may be adopted.

Since the only possible way to give nucleus crews the necessary familiarity with their boats is to familiarize them with their boats, any scheme for training crews must contemplate the moving about from station to station where the boats may be laid up, for the sake of practice with them and possibly for the sake of giving practice to the men who may make up the mobilization crews—real naval reserves or naval militia, or men from the fleet. In any case the actual running from time to time of all the boats that are to be mobilized for war must be provided for.

The running of all boats is necessary, not only for the efficient training of the nucleus crews, but for the insurance of in an efficient state of preservation, of the boats themselves.

Sufficient experience has been had with our torpedo-boats to accentuate the fact, well known abroad, that the hasty manning of laid-up boats with crews wholly green to torpedo-boat service and entirely unfamiliar with their particular boats makes strongly for great expense and pitiful inefficiency.

### Suggested Method of gaining the Desiderata and meeting the Conditions mentioned.

Keep seven representative boats in commission at all times, working to the southward in the winter and northward in the

summer. Interchange boats in commission and boats laid up from time to time.

Organize in the crew of each commissioned boat four nucleus crews, and detail each nucleus for a particular boat.

Wherever a boat is found by the cruising division, anywhere from Kittery to Pensacola, put her nucleus crew on board, fill the crew with details of other nucleus crews to represent the green men of general mobilization, and run the boat till her nucleus crew knows how she should be handled to get the most efficiency out of her, and until each man in the nucleus crew knows how to instruct green men in the necessary details of his own duties.

Any nucleus crew of any particular boat would of course be available for duty as such in any of the own sisters of that particular boat, but for the reasons given before—the great number of large and small differences in types in the small flotilla of thirty boats—the nucleus crews must be assigned each to a boat, not a number of nuclei to a group, although it is apparent and a matter of experience that any lot of men who have been trained in any way in torpedo-boat service are vastly superior for any boat in that service to men drawn from general service on their record of work in ships.

When not at work in connection with the laid-up boats, the commissioned division would be available for real torpedo-boat work drill in a group, torpedo practice, of which there should be much, torpedo-boat investigation of the coast, and when practicable, for maneuvers against the fleet. The boats should cover the whole coast in cruising twice a year, *i. e.*, they should work south from the Maine coast so as to be to the southward of Hatteras by November 1, and north from the Texas coast so as to be northward of Hatteras by May 1.

Group drill could not be exact for the reason that, in order to provide for a proper mobilization of the whole flotilla, which is the chief object to work, for even if there were never such a mobilization till the outbreak of war, the boats of the commissioned division would necessarily be of several types.

Still the group drill would be most valuable in itself; and, moreover, it would furnish a means for cultivating that spirit of rivalry in doing good work which make so strongly for efficiency. For economy, training and efficiency, experience has proved:

(a) That the crews themselves, and not dockyard people, should make the small repairs constantly needed in boats in commission, should do the tuning up and adjustment of the machinery of all kinds, and should arrange the small fittings so necessary for serviceability.

(b) That the keeping of pay and expense accounts of a number of boats in commission at a shore station is complicated, onerous and very unsatisfactory.

(c) That the attaching of boats to "mother ships" which are men-of-war, is impracticable for the reasons that boats "mothered" are nuisances to the ships, that the ships often prove indifferent stepmothers rather than cherishing mothers, and that from the nature of the service they should do in the mobile defenses, the boats should be independent of the men-of-war as they would have to be in time of war.

(d) That the hiring of machine tools in ports where there are no naval stations, and the general use of machine tools of a naval station by the torpedo-boats' crews are both objectionable.

All these results of experience, as well as many requirements not here enumerated but exacted by the peculiarities of our torpedo-boat service upon our long stretch of coast, point directly to the supplying of such a torpedo-boat floating base as was recommended by the Board on Auxiliaries in the autumn of 1898.

### TORPEDO-BOAT BASE VESSEL.

This should not be an expensive Vulcan, nor a collier pure and simple, nor a supply ship as such; but should possess certain features of all three craft, and could be readily fitted up by utilizing one of the unused colliers now on hand and deteriorating—the Lebanon for example.

This ship would need a wooden covered spardeck and a wooden covered maindeck. She should carry about 1000 tons of issue coal—two fills-up of seven commissioned boats of average coal capacity—paymasters' stores of all kinds needed by the boats, large supplies of oil and waste, and necessary engineers' stores, including the larger take-down tools belonging to the boats and heavier spare parts. A good amount of tankage and a good distilling plant would be necessary.

She should have a comfortable sick bay and a dispensary on

the main or spar deck; two or three regulation size brig cells on the main deck, a machine shop the size of the average one aboard a large cruiser but fitted with tools applicable to torpedo-boat work; a one or two crucible brass founding plant capable of handling castings for all torpedo-boat brasses except the heavier ones; and a small but applicable coppersmith plant. All these small plants could be readily accommodated on the main deck of a ship like the Lebanon and leave ample crew space for the ship's crew and room for occasional "rest details" from the boats' crews. The construction stores should include ample allowances of bottom, outside and inside paints, especially the preservatives, and small amounts of hull materials, plates, rivets, awning stanchion stuff, etc.

In equipment stores should be found ample amounts of good soft towing and mooring line stuff in the coil—4½-inch six-stranded Boston navy yard made manila for example—canvas for repairing awning and rigging rain-catchers, steel rope for ridge ropes and life lines, mess gear for fitting out recruits shipped aboard the base vessel, cooking utensils to supply losses and breakages, etc.

The supply of inflammables should be allowed, preferably on a six months' basis; at least for three months. The allowance of kerosene for cleaning grease out of boilers and machinery should be large enough to be used freely as a preservative. Turpentine allowance to correspond with paint allowance. Alcohol to be liberally supplied for shellacking the small crew spaces and officers' quarters of the torpedo-boats. The broaching tank system of stowing inflammable and explosive liquids on deck would be more convenient for frequent small quantity issues than the weather-proof package system, and has certain safety advantages in a ship with so small a crew as the base vessel would have, in that one man could broach all the tanks in a minute or two; with the package system the fire fighting of the crew would have to be slacked up while the necessary detail was getting the packages overboard. Inflammables afloat freely might be very disagreeable, but so would packages of inflammables. In a tide way or at sea both systems would work well when the stuff was once overboard. At slack water both would be highly objectionable.

For ships' boats the base vessel should have one good steam

cutter, capable of towing a 150-ton torpedo-boat handily, a couple of small ships' launches or strongly built cutters fitted with removable thwarts, for lightering stores, a couple of six-oared whaleboats and a dingy.

The cargo booms and derricks and her deck winches should be fitted for the work intended; but a very slight modification of the systems found aboard a collier would probably answer all purposes.

The foregoing outline of the salient points of a base vessel is sufficient to indicate her general character.

The great advantage of procuring stores in quantities sufficient for the seven torpedo-boats, and issuing them under one direction as needed is so much more economical than the single-boat supply method that it appeals strongly merely as an administrative measure, and apart from other apparent aids to efficiency that would follow from the use of a floating torpedo-boat base.

### COMPLEMENTS AND RATINGS.

From what has preceded it is evident: that a torpedo-boat's crew should be made up in such a way as to be competent to handle the average boat of the flotilla efficiently; that it should have in it a number of nucleus crews for mobilization purposes, and that it should be so organized as to provide organizes subdivisions which in greater or smaller numbers taken from one or more boats in commission may make up a crew for any boat in the flotilla, large or small.

An inspection of the complement lists shows that the assigned complements are as follows:

| | | | |
|---|---|---|---|
| | 1 | boat | 56 men. |
| | 1 | " | 53 " |
| 22 boats | 2 | " | 28 " |
| | 14 | " | 26 " |
| | 1 | " | 23 " |
| | 3 | " | 21 " |
| | 2 | " | 20 " |
| | 4 | " | 13 " |
| | 2 | " | No complement assigned. |
| | 30 | boats. | |

The 22 boats with assigned complements running from 20 to 28 men can all be efficiently handled by 25 men each, and can all berth those men when in commission, and therefore the changeable crew should consist of that number made up of four nucleus crews of five men each and five other men.

The two large boats and the six smallest ones should not be assigned to the cruising division at any time, because the large boats are too expensive and the small ones too small for coast work. In manning the large boats for practice running, each would of course have her own nucleus crew and would fill up with nine other nucleus crews, a chief machinist and chief gunner's mate from the cruising boats. The small boats would be taken out each by her own nucleus crew, one other nucleus and a couple of chief petty officers.

The nucleus crew should consist of five men, because there are five duties aboard a torpedo-boat, each of which requires an experienced man as instructor and illustrator when filling up complements with green men.

The ratings sufficiently explain the duties of the nucleus crew men as instructors, although, as must always be the case in torpedo-boats, the men below must do all-around work below, and the men on the deck the same. Gunners' mates, for example, must do the steering as well as lookout for torpedoes, etc.

A nucleus crew when fit for work as such should consist of 1 G. M., 1st class; 1 machinist, 2d class; 1 W. T., 1 oiler, and 1 fireman, 1st class *i. e.*, two engine-room men, two fire-room men and one deck hand, and the ratings should not go above these, though of course men when first taken on for nucleus crews could hold lower rates but should be capable of holding the rates mentioned after instruction or they would not be fit for nucleus men. The rates should not be higher, because the pay of those rates is sufficiently high for duties done in the running of commissioned or other boats. These rates are selected because the rates of pay are fairly uniform, as they should be, when the duties run into each other. For example, the oilers would have to do machinists' work and vice versa, the water-tenders would have to fire and the fireman pass coal, fire and tend water. And, moreover, there should be a certain amount of interchange of duties between the fireroom and engine-room men to make the nucleus crew what it should be.

The five extra men for a commissioned boat's crew should be 1 chief gunner's mate, 1 chief machinist, 1 ship's cook 2d class, 1 steerage steward and 1 landsman mess cook. These five men with four nucleus crews should make up the crew of a commissioned boat. Seven such crews would furnish nucleus crews for twenty-eight boats, and a chief gunner's mate or a chief machinist to fourteen boats.

The complement of officers for each boat should consist of 1 lieutenant in command and 1 subordinate officer, an ensign, naval cadet or gunner. Each officer to be detailed for one year with a relief of either the commander or the subordinate every six months, so that after the system was in running order every commissioned boat would always have one officer with at least six months' experience, and in two years there would be experienced officers available for commanding officers of all boats.

COMPLEMENT OF THE BASE VESSEL.

1 Chief master-at-arms.
1 Chief boatswain's mate.
1 Chief gunner's mate.
1 Chief carpenter's mate (wood and steel work).
3 Coxswains (quartermaster watch at sea).
3 Seamen (helmsmen at sea).
1 Chief machinist.
1 Machinist, 1st class.
3 Machinists, 2d class.
3 Firemen, 1st class.
3 Firemen, 2d class.
1 Boilermaker.
1 Electrician, 1st class.
1 Coppersmith.
1 Blacksmith.
1 Brassmolder.
1 Painter.
1 Shipwright (wood and steel worker).
2 Chief yeoman (1 pay and flotilla, 1 equipment and flotilla).
1 Yeoman, 1st class (nav., commanding officer and flotilla writer).
1 Hospital steward.
1 Hospital apprentice.

1 Ship's cook, 1st class.
1 Ship's cook, 4th class.
1 W. R. steward.
1 W. R. cook.
1 Steerage steward.
1 Steerage cook.
5 Mess attendants.

And enough landsmen and coal-passers for passing coal, for mess cooks and for handling cargo as required by the particular vessel selected for the floating base.

OFFICERS FOR BASE VESSEL.

1 Commander, commanding flotilla.

Duty aboard base vessel for administration; aboard flagboat of cruising or trial division at sea and for all division drills.

1 Lieutenant-Commander, commanding base vessel.
1 Lieutenant.

Executive and flotilla construction, equipment and recruiting officer.

1 Lieutenant.

Chief engineer of base vessel and flotilla engineer. Should be a real engineer officer and preferably one who has had torpedo-boat experience.

1 Lieutenant, junior grade.

Navigator and flotilla ordnance officer.

3 Gunners.

Sea watch. Each assigned to superintend repair work of certain kind.

1 Assistant surgeon.

Flotilla surgeon.

1 Assistant paymaster.

Flotilla paymaster and storekeeper.

1 Pay clerk.
1 Warrant machinist.

Sea watch. In charge of machine shop and machine tool work in port.

## Number and Kind of Men needed for Torpedo-boat Service and Method of obtaining them.

The seven full crews each made up as shown of nucleus crews and extra men would require 175 men. The crew of the base vessel would require approximately 65 men—240 men all told to carry out the scheme outlined. The men for the torpedo-boat crews would have to be young, active, energetic and with a good but not unusual amount of physical endurance.

The machinists and firemen of the base vessel, if no others of her crew, should possess the same physical characteristics, so as to make transfers to the boats upon occasion.

From the nature of the service and the consequent impossibility of keeping up the kind of police restrictions usual on board ship, all the men would have to be reliable as regards tendency to smuggle liquor aboard, and as regards drunkenness ashore. In other words, all the men would have to be as reliable in these respects as perhaps 80 per cent of the men in general service now are.

All the nucleus crew men, the chief machinist and the chief gunner's mate of a torpedo-boat's crew, as well as a large proportion of the base vessel's crew, should have sufficient knowledge of the use of machine and hand tools to make the repairs contemplated in the scheme. Therefore somewhat different though not higher qualifications would be required of them than of men of corresponding rates shipped for, or rated up in general service.

The men of the nucleus crews would have to be made up of men intelligent enough to progress to the higher ratings, but they could not expect to reach these higher ratings because their duties in the boats would not warrant the expense, and because transferring them to ships where they might reach the higher rates would defeat the prime object of the organization—the having at all times efficient nuclei for mobilization purposes.

Again, there should be a direct and efficient way of discharging men found to be not adapted to torpedo service. Some good men, for example, who are efficient aboard ship suffer so from seasickness in torpedo-boats that they are useless for that service. It is evident that inducements to enter the torpedo-boat service must be found to offset the depriva-

tion of chance for higher rate and pay, and to make up for the harder work required, and for the lack of comforts.

To a great number of men in the country qualified for torpedo-boat duty, and surely to enough for the small number required, a particular service in which there was the esprit due to more or less selection and to the idea of desperate service in war—in which duty was confined to our own coast, and in which there was comparatively more individual responsibility, would present attractions that would fully make up for the disadvantages as compared with general service conditions, provided these attractions and the consequent stability of torpedo-boat service were assured.

For these reasons the men for the boats and base should be special service men and so shipped, or transferred; and in order to assure them that their status is secure when they are qualified, and to give an easy and direct method of sorting out the non-adaptable, their status should be more or less that of revenue cutter or coast survey men. It is to be observed that qualified men whose enlistment for three or four years in torpedo-boat service had expired, and who chose to ship for general service might be kept run of for mobilizations details. But these men, like qualified men who had given up the torpedo-boat service for shore occupations, while making for the possible number of qualified torpedo-boat men in the country for war service, could not be depended upon as attainable for quick mobilization of the whole flotilla.

After the system was in running order the recruiting for the torpedo-boat service should be done on board the base vessel, and after the system was developed the cruising division would be independent of dockyards for all repairs barring such as have to be made in drydock.

A few of the nucleus crew ideas might have more or less application to destroyers; but as the destroyer is theoretically a vessel of the fleet, while the torpedo-boat is a vessel of the mobile coast defense pure and simple, what applies to the one can have little application to the other, until there is a more general recognition of the fact that, after all, the two types are of one kind.

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# A LITTLE UNWRITTEN HISTORY OF THE ORIGINAL U. S. S. MONITOR.

By G. TOTTEN MCMASTER, M. D.

Associate Member Naval Institute, Associate Member Military Service Institution, Member of Connecticut Medical Society, Member of New Haven County Medical Society.

It is useless to dwell upon the events of the Merrimac's construction and the general consternation about its fancied ravages when floated. Suffice it to say that the Galena and Ironsides, though under construction, would not be ready to meet the southern monster.

The Navy Department and those in authority had been tormented by a flood of impecunious and vacuous inventors who for their own interests (let alone the nation's safety) dogged their steps persistently, and it is no wonder that when any idea was brought to their notice they were on their guard.

The man that I bring before the gentlemen of the navy in this sketch was neither officer, seaman nor marine. He was not in the battle, did not observe it, but was the power behind Ericsson, in that he first interested Secretary Welles and was the means of obtaining the money and iron.

Cornelius S. Bushnell, of New Haven, Connecticut, merchant, contractor and promoter, first put the Monitor in the way of being a fact and not a fad.

Bushnell had the Galena under construction, and while not yet finished, grave doubts were raised by naval experts as to her stability, viz., if she could carry such immense weight in armament and protection and yet be seaworthy.

Being alarmed at such frequent doubts expressed by naval men, Bushnell repaired to C. H. Delmater for advice.

This individual advised Bushnell to interview Ericsson himself, giving the latter the requisite materials to draw up his calculations for results.

Acting on this counsel, Bushnell met the inventor on Thursday, October 17, 1861, Ericsson asking him to call next day to get his (Ericsson's) verdict.

So on Friday, October 18, 1861, Bushnell returned to get his answer. The inventor's speech at this time was characteristic: "She will easily carry the load you propose and stand a six-inch shot, if fired from a respectful distance." It was at this meeting that Ericsson asked Bushnell if he could spare him a few moments, that he had a design for an impregnable battery, that could be built and put into operation in 90 days.

Bushnell listened with interest; he perceived the value of the little boat, and in a few words it was agreed that he (Bushnell) should take the plans to the Secretary of the Navy.

At this time Mr. Welles was at home for a few days. Bushnell left New York, Friday, October 18, 1861, and went direct to the Secretary's house in Hartford, Conn.

Exhibiting the plans and model to Mr. Welles, who seemed interested, and requested his visitor to start for Washington and bring it before the naval board, and that he (Gideon Welles) would arrive in the Capitol in a few days and give Bushnell the contract.

The Naval Board at this time consisted of Commodore Joseph Smith, U. S. N.; Commodore Hiram Paulding, U. S. N.; Captain C. H. Davis, U. S. N.

The plans had not been in Bushnell's hands 24 hours when he had seen Secretary Welles and was on his way to Washington (Saturday, October 19, 1861) to take the final steps.

Arriving in Washington, Sunday, October 20, 1861, Bushnell summoned the subcontractors for the iron of the Galena (Messrs. Winslow & Griswold) and divulged the design and plans of operation he intended to pursue.

Mr. Bushnell was aware that a plan so novel as a boat practically submerged would meet with strenuous opposition at the hands of the naval chiefs. The explosion of the Princeton's gun was as yet fresh in their memories.

After due deliberation the contractors determined to call upon Secretary Seward, request his influence and a letter to President

Lincoln (this was on Monday, October 21, 1861). Obtaining a letter from Secretary Seward, they set out to interview the executive.

President Lincoln received Bushnell and his companions with his usual kindness, evincing some interest in the little model. He informed them that "he knew little about boats, unless it was a flat boat, of one of which he was master in earlier life." He assured the contractors that he had no power in the matter, that that was vested in the Naval Board, but he would meet them next morning (Tuesday, October 22, 1861) at 11 in Rear Admiral Smith's office.

At the hour fixed upon by Mr. Lincoln, Bushnell and the sub-contractors were at the Department. The model was presented and explained. The expected opposition was poured forth by old and young officers without stint, with the exception of Rear Admirals Smith and Paulding, the most powerful members of the board, who absorbed the situation and took in its merits and defects as only unbiased intellects can.

President Lincoln remained during the argument, which waxed heated at intervals, and listened with attention, not venturing much either for or against until Rear Admiral Smith asked his opinion.

Mr. Lincoln arose and observed: "All I have to say is what the western girl said when she put her foot into the stocking—'It strikes me there's something in it.'" Then with a courteous salutation to all present, the President left the apartment.

Rear Admirals Smith and Paulding were anxious to recommend its adoption if Captain Davis, the other member of the board, would consent, but the latter officer would not risk his reputation on the merits of this fanciful craft. All arguments that Bushnell and his fellow-contractors could bring to bear were of no avail.

A unanimous vote of the board could not be obtained, and Captain Davis, turning upon Bushnell with some little temper, exclaimed: "Take the little thing home and worship it; it will not be idolatry, as it is not like anything in the heavens above, or the earth beneath, or in the waters under the earth!"

Thus ended the interview. Sadly did Bushnell leave the department, with a heavier heart than he had carried with him for many a day.

In desperation he reported to Secretary Welles. Using his own words, which aptly described the situation, he says: "All was dark about me for an hour that Tuesday (October 22, 1861), but Secretary Welles cheered me up by saying that some influence should be brought to bear on Davis. I caught the idea and said if I could only get Ericsson to come to Washington himself to meet the board in Secretary Welles' room, the magnetism of Ericsson would carry all before him."

Bushnell was aware that Ericsson had taken a solemn oath never to set foot in Washington until the Government had paid his bill for the Princeton, and stated this fact to the Secretary. But nothing daunted, he determined if possible to make the inventor break his oath. Leaving Washington on Tuesday, October 22, 1861, for New York, Bushnell racked his brains for some means to shake Ericsson's strong resolve. At last he remembered the delight that the inventor had evinced when he (Ericsson) displayed a medal given him by Napoleon III.

Arriving in New York that night, Bushnell calmed himself for the ordeal by a well-needed night's rest, and at 9 o'clock Wednesday morning (October 23, 1861) we find him at Ericsson's home in Franklin Street, the inventor opening his own door and in excited tones asking: "What is the result?" "Magnificent," said Bushnell.

As this conversation is historical, I shall use Bushnell's own account. "Well," he said, "what?" I (Bushnell) said Paulding says your boat would be the thing to punish those rebels at Charleston. His countenance lit up. I knew then that I had him. I said, "You have a friend in Washington, Commodore Smith; he worships you. He says those plans are worthy of the genious of an Ericsson." Didn't fire come in his eyes? "You see how it works," I said. "Captain Davis wants a little explanation in detail, which I could not give." He (Ericsson) said "I will go to-day," and he started (October 23, 1861).

Bushnell remained in New York after this talk and awaited developments.

As events go by contraries in this world of ours, the very first person Ericsson met in the Department was Captain Davis. "I have come down," said Ericsson, "at the suggestion of

Mr. Bushnell, to explain about the plan of the Monitor." "What?" exclaimed Davis. "The little plan Bushnell had here Tuesday? Why, we rejected it in toto." "Rejected! What for?" inquired Ericsson. "For want of stability," returned Davis. "Stability," roared Ericsson. "No craft that ever floated was more stable than she would be; that is one of her great merits." "Prove it," said Davis defiantly, "and we will recommend it at once." "I will go to my hotel and prepare the proof," said Ericsson, "and meet your board in the Secretary's room at 1 o'clock" (Thursday, October 24, 1861).

At the appointed time, with his arguments well in order, Ericsson appeared. He succeeded so well that before he left the Department, Secretary Welles asked the price. $275,000 was the answer. The Secretary turned to Commodore Paulding and inquired: "What do you say?" "I vote to recommend the contract," was Paulding's answer. "And you, Commodore Smith; what do you say?" "I vote for it," said Smith. "And what do you say, Captain Davis?" "I vote for it," rejoined Davis.

"Then," said Mr. Welles, turning to Ericsson, "go home and start her immediately, and send Bushnell down next week for the formal contract."

Ericsson started for New York at once and arrived late the night of October 24. At the station Bushnell, Winslow and Griswold met him. A short talk and all was settled, for during the inventor's absence they had put all in readiness to start at the word, and now they did.

On Friday October 25, 1861, the keel of the Monitor was laid, even before the formal contract was signed, and on January 30, 1862, she was launched, just 106 days in all, counting Bushnell's work and the labor.

C. H. Delmater & Co. were given the construction of the machinery, engines and boilers. The hull and turret to T. F. Rowland. All engaged in the work put on extra hands and worked over time to finish the little boat.

The week of October 28, 1861, Bushnell went to Washington for the formal contract. To his dismay he heard the Naval Board predict "another Ericsson failure." They (the Naval Board) demanded a guarantee of perfect success for the boat, or a refunding of money already advanced. Unfair as the demand

was when so much had been risked, Bushnell determined to push it through, cost what it might.

Winslow objected to such skulking terms. Griswold said he would go on if Bushnell could get bondsmen.

Again Bushnell set to work. He got the Hon. N. D. Sperry, of New Haven (now U. S. Representative in Washington), who was willing to give any amount, and Daniel Drew, of New York, as bondsmen, and at last cleared away all the obstacles that had been put in his way.

The success of the venture needs no recital here, having been set forth by far abler pens than mine, but I imagine that the part played by C. S. Bushnell in the defense of his country is not generally known.

C. S. Bushnell in taking up the work of putting the Monitor through risked all he had in the world. His energy and foresight to make the Monitor a success cannot be based entirely upon a desire for money, for he died a poor man at last.

In order that this unknown patriot may not be passed over in history, and that he may have his share of honor, this sketch is written.

### Substantiations for all Statements.

The facts stated above are drawn from letters of the late C. S. Bushnell. An address that he (Bushnell) delivered before Army & Navy Club of Connecticut, on June 22, 1894, has been drawn from largely; also a letter written to the Hon. Gideon Welles by Mr. Bushnell, reciting the above incidents and asking corroboration of his statements. The answer of the former Secretary I append in full. All these letters and the mass of papers relative to the Monitor are in the possession of his sons, Ericsson F. Bushnell and Winthrop G. Bushnell, of New Haven, Conn.

One very peculiar thing about all C. S. Bushnell's most interesting paper is the lack of dates given. Now to make up this deficiency, I have taken the date of laying of the Monitor's keel and the calender for the last half of 1861, to be found in Vol. 6, Series I, Official Records of the Union and Confederate Navies in the War of the Rebellion, and also from this sentence in the speech of C. L. Bushnell above mentioned: "This was just eight days after the plans were first shown me" (namely,

when the keel was laid). To be sure, this is speculation, but I venture to say I am not far out of the way.

Item. "Report of the Secretary of the Navy in relation to Armored Vessels," Washington, 1864, page 6, I see C. S. Bushnell Co., of New Haven, is mentioned.

The original contract for the U. S. S. Monitor is doubtless accessible to all officers in the Navy Department, Bureau of Yards and Docks.

I append Secretary Welles' letter, as follows:

HARTFORD, 19 March, 1877.

*C. S. Bushnell, Esq.*

MY DEAR SIR.—I received, on the 16th inst, your interesting communication, without date—relative to the construction of the Monitor.

Many of the incidents narrated by you I remember, although more than fifteen years have gone by since they transpired. Some errors, not very essential and caused by lapse of years, occur—Sedgwick, not Rice, was chairman of the Naval Committee; Griswold resided in Troy, not New York, and subsequently represented the Troy district in Congress, etc., etc.

I well remember asking you to put in writing the facts in your possession concerning the construction of the Monitor. Some statements of General Butler, Wendell Phillips and others to disparage the Navy Department, prevent the truth and deny us all credit, led Admiral Smith, in the autumn of 1868, to address to me a communication, reciting the facts, for, he said, when we were gone those of us who took the responsibility and would have incurred disgrace had Ericsson's invention proved a failure, would be ignored and history mis-stated.

As you were more intimate with the case at its inception—were the first to bring it to the attention of the Department—it seemed to me proper that your recollections and knowledge of the transaction should be reduced to writing.

I am greatly obliged to you for the full and satisfactory manner in which you have complied with my request. Next after Ericsson himself, you are entitled to the credit of bringing his invention to the knowledge of the Department.

I would not knowingly do injustice to any one, and I am well aware that the official in the civil life and who in administering the government directs movements by which naval and military men acquire renown, is often by the passing multitude little thought of and scarcely known, but the truth should not be suppressed.

The civilians of the Navy Department, who adopted and pursued through ridicule and assault the Monitor experiment, Butler and others would slight and defame.

In the history of the war, the Navy Department which originated, planned and carried forward the naval achievements from Hatteras to

New Orleans, and finally Fort Fisher, is scarcely known or mentioned. The heroes who fought the battles and periled their lives to carry into effect the plan which the Department devised have, deservedly, honorable rememberance, but the originators and movers are little known. I remember, my dear sir, your earnest efforts in the early days of the war, and the comfort they gave me. Yours,

GIDEON WELLES.

The above letter substantiates all above written, and C. S. Bushnell's sons can show it.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

# SMOKELESS POWDER

By LIEUTENANT JOSEPH STRAUSS, U. S. N.

The invention of smokeless powder marks an advance in the science of artillery ranking in importance with that of the breech-loading cannon. Measured by muzzle energy, the change in ordnance construction from cast-iron to steel has not contributed more to the improvement of artillery.

In 1852, seven years after the invention of gun-cotton, Captain Von Lenck of the Austrian army first made use of it as a propellant in guns. So far as smokelessness was concerned, he was of course successful, and its use continued in Austria for about ten years. In 1862, the gun-cotton factory was destroyed by an explosion and the manufacture ceased, notwithstanding the fact that the new powder had come into use to a considerable extent.

The gun-cotton as made at that time was unstable; no efficient means had been discovered for entirely freeing it from the residual acids used in the process of nitration; this difficulty was overcome by Frederick Abel who invented the process of grinding the cotton fibre in a paper-mill after nitration, thus reducing the minute tubes to short length and making it possible to remove the acid from their interior.

Von Lenck spun the gun-cotton and laid it up into ropes; this prevented its burning too rapidly, and when Abel overcame the difficulty of instability the material was no longer in a form that would permit its rate of burning to be controlled. About this time Captain Schultz of the Prussian Artillery nitrated wood cut into thin sheets and this powder has been used ever since for sporting purposes.

In 1886, Vieille produced the first practical military smokeless

powder, since however abandoned; this consisted of gun-cotton dissolved in ethyl ether and mixed with picric acid. In 1888, cordite was invented in England and has been used ever since.

Cordite is a mixture of 58 parts of nitro-glycerine with 37 parts of high-grade gun-cotton and 5 parts of vaseline. The gun-cotton is soluble in nitro-glycerine, but with difficulty, and to overcome this acetone is used as a solvent for both and then dried out. Ballistite, which is used in Italy and Austria, is very similar to cordite, only a different solvent is employed.

Cordite is squeezed out in a vermicelli press in smooth cords of varying thickness, depending upon the size of gun it is intended for. Its color varies from a light yellow to brown and the cords bend like vulcanized rubber and are about as hard to the touch as stiff beeswax.

There are only two general classes of smokeless powder in use; those consisting of a mixture of nitro-glycerine and gun-cotton as above described, and those consisting of gun-cotton alone, dissolved in a suitable solvent pressed into the desired shape and then having nearly all of the solvent removed by evaporation. The latter class are generally referred to as "gun-cotton powders." It is to this class that the Navy smokeless belongs.

The Navy powder is a solution of three parts by weight of soluble nitro-cellulose in two parts of ethyl ether and one part of ethyl alcohol. When mixed in a mechanical bread-kneader, the substance has the appearance of damp cornmeal. Under a pressure of a couple of hundred pounds per square inch, the solution is completed and the mixture has the consistency of stiff dough, small masses of it being translucent. From this stage it is pressed into suitable grains and nearly all of the solvent evaporated off. About one or two per cent. of alcohol remains in the powder, it being extremely difficult to expel the residual solvent to a lower point than that.

In the original Navy smokeless it was specified that the nitration should be in the neighborhood of 12.45 per cent; in other words, the nitrated cotton should consist of cellulose nitrates the mean nitrogen contents of which should be 12.45 per cent. Furthermore, all but two per cent should be "soluble." This word "soluble" is used in speaking of gun-cotton in a special sense. It means soluble in a mixture of ether and alcohol.

Prof. Mendeleef has demonstrated that a gun-cotton contain-

ing 12.44 per cent. nitrogen will give a greater volume of gas than any other. Experiments at Indian Head have proved that the nitrogen may be increased to as much as 12.80 without adversely affecting the velocity. Mr. G. W. Patterson has shown that owing to the impossibility of getting rid of all of the solvent the nitrogen should never be as low as 12.44. In the very smallest grains there remains never less than one-half per cent. This is probably nearly all alcohol and to provide for the oxidation of this it is necessary to increase the nitration, the amount of increase depending upon the size of grain, for the reason that the quantity of residual solvent is a direct function of the wall-thickness. However, about 12.80 is the highest nitrogen that can be obtained with a resulting solubility within the 98 per cent. demanded by the specifications; therefore, nitrations between 12.45 and 12.80 are permitted.

The amount of nitration depends principally upon the strength of the nitric and sulphuric acid used. With the very strongest nitric acid the result produced will reach as high as 13.1 in ordinary practical working. That would be insoluble military gun-cotton and only useful so far as we are concerned for mines and torpedoes. Such gun-cotton is easily soluble in acetone but the dried colloid where acetone is used as a solvent is brittle. The colloid produced by ether-alcohol is decidedly tougher and therefore much less likely to break up in the gun. For obvious reasons it is important that this should not take place.

In the powder manufactured abroad so far as we have been permitted to observe them, no effort is made to have the gun-cotton all soluble. Nor is it certain that such a result is necessary. With that condition thrown out it is easy to obtain high nitrations.

*Physical Characteristics.*—The Navy Smokeless powder varies in color from a light lemon to a deep brown, almost black. These variations in color depend generally upon variations in the process of manufacture, although the region in which the fibre is grown may have an influence. If pure clear water is used in the various processes of washing and boiling the gun-cotton the powder is clear or at least translucent. If the water is contaminated with iron salts the powder is brown and opaque.

The grains are about as hard as horn but not so tough. They can be readily turned in a lathe and take a fine finish. Minute

particles can be exploded by striking them with a hammer, but only the portion struck will explode.

The powder ignites at about 180° C. which is a considerably lower temperature than that required to ignite black or brown powder. Notwithstanding this low ignition point, the material is much less inflammable than black powder and this constitutes a serious disadvantage which will be referred to later.

*Ballistics.*—It is certain that the powder is absolutely progressive in its burning. When small charges are used with consequent low pressures and rates of burning, it frequently happens that partially burned grains are recovered in front of the muzzle of the gun. In all cases it has been observed that the outside diameter has been reduced and the inside diameter of the perforations increased in exactly equal amounts. The walls may be reduced to the thinness of paper, but the general structure of the grain remains intact.

The two great advantages pertaining to smokeless powder are first, that the entire weight of the charge is reduced to gas and becomes useful in propelling the projectile, and second, that the target is not obscured by smoke. I have given second place to the latter quality advisedly. As an example of the importance of the first point, let us compare the weights and velocities obtained with the 6-inch 40-cal. gun using brown powder and smokeless. A charge of 45.5 pounds of brown-prismatic gives in this gun a velocity of 2000 f. s. with 15 tons pressure; twenty pounds of smokeless gives the same velocity with 10.8 tons pressure. If the pressure curves for the two powders were the same in general form, this equality in velocity of the two powders would be unaccountable since the maximum pressure with the new powder is 28 per cent. less than the old. As a matter of fact the curves are very similar and the area embraced by the smokeless curve is less than that contained in the curve of brown powder-pressures. In the latter case, however, it must be remembered that but about 35 per cent. of the weight of powder becomes gas useful in propelling the projectile; there remains 65 per cent. in the form of smoke and residue left in the bore. Suppose 50 per cent. consists of smoke, that allows for about seven pounds of residue (which is undoubtedly an overestimate) and we then have the useful gas propelling a projectile weighing 100 pounds, plus about 23 pounds of inert products of combustion

in the shape of smoke, making a virtual projectile of 123 pounds weight.

The relations of weight, pressure and velocity given in the single instance above do not always hold good. The powder must have a wall-thickness exactly suitable to the size of the chamber and length of the bore or else all of the powder will not be consumed in case the powder is too thick, or in case it is too thin the powder will burn rapidly and the pressure will be too high. The one case makes the chamber end of the gun do excessive work and the other throws the strain on the chase and muzzle. Thus, it is quite as important to the safety of the gun not to have too low a maximum pressure for a given velocity as to have one that is too high.

In guns fifty calibers in length with chambers large enough to accommodate a charge having about 45 per cent. of the weight of the shell, a velocity of 3000 foot-seconds is obtained with a pressure of 16.5 or 17 tons per square-inch. These results have been obtained with a 6-inch gun of 46 calibers. A velocity of 3380 f. s. was produced in a 5-inch 50-calibre gun, the shell weighing 50 pounds, the resulting pressure having been 15.8 tons. With a 60 pound shell the velocity was 3200 f. s. using a charge equal to that employed in producing the higher velocity with the lighter shell. In the latter case the pressure was 18 tons and the smaller amount of energy produced in the former can only be accounted for by the presumption that the powder was not all burned up, a result that would be produced when the pressure was too small to keep up the rate of burning. This of course was due to the lighter projectile moving forward under a lesser impulse than was required for the heavier.

Considerable disappointment is felt that the discharge of a gun using smokeless powder produces so much smoke. The powder-charge proper is really smokeless, the only smoke produced coming from the ignition charge. The lack of inflammability of the powder renders the employment of the ignition charge indispensable. For a 6-inch charge 100 grams of fine-grained black powder is about the least amount that will insure proper ignition. For a 13-inch charge weighing 300 pounds, a 14-pound ignition charge is used. Relatively the 13-inch charge requires something like seventy times as much black powder as the 6-inch. With the latter, the smoke does not obscure the target

at all, but the smoke from the 13-inch is considerable. Fortunately it is so intermixed with the large volume of colorless gas that it dissipates readily enough not to seriously hamper the aiming. At the Proving Ground it was found that a point four miles distant was visible in five seconds after firing the 13-inch loaded with smokeless; with brown powder the time taken was twenty-five seconds; this was in calm weather; with anything of a breeze the five seconds would of course be lessened.

All attempts to reduce the amount of black powder result in decreased velocities, long hang-fires and increased pressures. The first is probably caused by not having all the powder consumed; it can be remedied by increasing the smokeless charge, but this not only increases the expense but probably burns powder in the wrong part of the gun. The hang-fires could not be overcome and they would be long enough to interfere with good shooting. The increased pressures are due to igniting a portion of the charge first, and setting up "wave-motion" by the released gases balloting back and forth from one end of the chamber to the other thus getting the dynamic effect of their weight.

It is necessary to fill the entire chamber with flame so as to instantaneously ignite all portions of the charge at once to avoid these effects and, so far, fine black powder is the only substance that has afforded the necessary inflammability to accomplish the desired result. It naturally occurs to one that smokeless powder so finely divided as to have a large amount of burning surface would be sufficient. This has been tried using all varieties of fine-grain smokeless including shot-gun powder, pistol-powder and even powder dust.

In the 6-inch the substitution of 50 grams of 60 mm. smokeless for the regular 100 grams of black powder has resulted in an increase from the normal pressure of 16 tons to the high one of 20 tons; and this with a perceptible hang-fire.

*Stability.*—The powder being nothing but gun-cotton with a small percentage of alcohol and a trace of ether included in the mass, its stability depends on the stability of the gun-cotton. That of course in turn depends on the purity of the gun-cotton. This substance has a long and favorable history, and when it has failed in keeping qualities the failure has always been due to imperfect preparation.

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# SUBMARINE BOATS.

## TACTICAL VALUE AND STRATEGICAL CONSIDERATIONS.

(Extract from a lecture delivered at the War College, September 13, 1901.)

By COMMANDER W. W. KIMBALL, U. S. Navy.

### TACTICAL VALUES.

The chief of these owes its existence to the fact that the approach of a boat under water cannot be stopped by gunfire, and that therefore sure torpedo range can be reached in daylight in spite of gunfire, per se. Since the boat at a working depth of from thirty to forty feet cannot satisfactorily direct her course upon an object constantly changing its position, and since a ship can not only change her position, but can change it at a speed much greater than that possible for the boat, it is evident that the ship could keep out of torpedo range after sighting the boat or otherwise becoming aware of her being in the vicinity before she got home, just as a fast cruiser can keep out of gun range of a battleship. It is very generally concluded that a battleship has a considerable tactical value when opposed to a fast cruiser because within her more limited area of effective action the former can, owing to her strong defensive power in armor and her strong offensive power in gun fire, compel the latter to move out of that area. Just so, owing to her invulnerable defense of water cover and the strong offensive power of her torpedoes, can the submarine compel the battleship to move out of the very closely limited area of effectual action of the boat.

The differences, then, between the tactical values of battleships

versus cruisers, and submarines versus battleships are those of degree rather than those of kind; and therefore if a battleship be very good against a cruiser a submarine must have some tactical value against a battleship.

The chief factors that define the boat's degree of value are small radius of effective operation, slow speed, indirect approach when invulnerable to gun, torpedo and ram attack, and the necessary giving up of complete invulnerability from time to time for the sake of correcting direction of approach.

From the data given in the table * it would seem that while the radius of movement calculated for is about 400 miles—though why this distance should not be quadrupled by utilizing ballast tanks for fuel stowage I cannot conceive—the radius of effective operation, i. e., the distance through which the boat could move in continuous diving, i. e., fighting trim at full speed, is less than thirty miles.

Reducing this distance by the good margin of 33⅓ per cent and making it twenty miles we arrive at a figure which seems to place the boat in the mobile coast defense,—in the offensive-defensive not in the harbor defense class—and to determine the distance off shore from which she could fight all the way into the beach. She could, of course, exhaust her submerged or fighting endurance in one continuous effort, or could come to the surface at a safe distance from the enemy and renew her submerged-running power, or could guard a position all day by using her under water power economically, according to circumstances. With the radius of effective fighting operation fixed at twenty miles, the effect of slow speed becomes apparent. For example, it is clearly seen that if a 14 K. battleship avoided a single 7 K. submarine twenty miles off shore and ran close in, she could operate there about an hour and a half before the boat could arrive and drive her off.

With a number of boats holding a line against the advance of a number of ships the disadvantage of slow speed is greatly lessened, as will be seen if we suppose that a line of 7 K. boats with six mile intervals opposed the advance of 14 K. ships whose direction of approach can be made out at six miles. If the ships came on in column the boat nearest ahead would close to inter-

* Omitted.

cept; and since the greatest distance that a boat would have to move through to do this would be half the interval, equal to half the distance the ship would have to move to reach the point of crossing the line, it is evident that as far as speed alone is concerned one or two of the 7 K. boats could reach the point of interception and make matters very interesting for the leading ships; while the ships that succeeded in passing the line would be in the best possible position for the boats to close on and force a second passing of their line by making the inshore region too dangerous for occupancy.

As before, the ships that got through the line could operate inshore for an hour and a half, if, as supposed, all available submarines were put on the line, and none held inshore, in reserve. If the ships came on in line or group formation the boats would of course have a greater number of chances for successful work.

In regard to the defect of indirect approach, it is to be noted that this only becomes serious in long submerged runs, and that tactically, there is no reason or excuse for such runs in the attack upon ships. Such long underwater runs would only be useful when hauling off after the torpedoes were expended.

In manoeuvring for position as just supposed the boat would be steered by continuous direct vision till within 6,000 yards or less, at which distance the chance of striking an indistinct target a few inches high at quickly changing ranges from a ship moving at speed may be considered nil. After that and until the ship were within 2,000 yards the dives would be short and the bearing well kept; for it may be taken for granted that the chance of scoring by the guns of a ship moving at 14 K. is practically nil when the object aimed at is a water tinted cylinder a few inches high that disappears for three or four minutes and appears for not more than ten seconds at a time and at a different place each time. If the ship is heading across the boat line, as supposed, the captain of closing boat will know that she will cross the line in from four to five minutes from the time she is a mile away, that the boat will in that case be within sure torpedo range of a broadside target within that time, and so will not stay down more than three minutes. If the ship holds her course the boat will have a sure shot as she breaks water; if the ship changes her course a few points either way the chance for one or the other of the closing boats is still good; if the ship puts her

helm hard over and goes about the chance is not good, though with hard over helm the ship would present a fair target at from 1300 to 1500 yards, which with Obry gear and the torpedo really kept in order, would be worth trying for. In this case the loss of a sure shot is due, not so much to the boat's lack of direct approach as to the superior speed of the ship in running away, and it may be remarked that if the ship runs away, the boat has accomplished something. Only when the boat rises within sure torpedo range—400 to 500 yards—does the ship have a practical chance of sinking her; and not then before her torpedo is away. To sink her a fair hit with at least a 4-inch would be necessary—and the gun practice that could be relied upon to do that in ten or fifteen seconds would have to be rather fine.

I have gone into this matter of method of approach, ad nauseam perhaps, because for some reason that I cannot comprehend, there exists, even today, a widespread idea that since a submarine can dive she must necessarily remain under water and blindly grope about there; and that if she does not do so she must be hampered with much befogging terms as submersible, or immersible or emerger or submerger, terms full of sound and signifying less than nothing at all. One hears even in the year of grace 1901, expressions of pseudo-expert opinion to the effect that submarines can never be useful until some method of seeing under water is arrived at. While under-water vision would greatly add to the tactical value of the submarine, provided she possessed this quality and her surface enemy did not, it is sure that, if she could see under water only at the expense of being seen, her utility would be less than it now is, since she could not conceal herself in short dives and could, much more easily than now, be struck by surface craft as she rose for a shot whether she broke water with her conning tower or used a camera lucida or periscope.

The sumbarine is slow always, and intermittently she is blind; but she has speed enough to be useful when working on interior lines against fast surface craft, she does not altogether lose sense of direction when she becomes blind for the sake of becoming invulnerable and she possesses the enormous tactical advantage of that third dimension movement which is denied to surface craft. She can move out of their field of action without going away—or into it at will.

In one of the late British Service Journals there is a statement to the effect that a destroyer stripped of gun and tubes and equipped with a stern towed spar torpedo on a forty foot boom could destroy a submarine by towing a boom against her when she was ten feet under water. Why a submarine should run at ten instead of thirty or forty feet does not appear; nor does it appear how the destroyer could, when the submarine showed for a few seconds, head for her and strike her with the spar torpedo before she attained a safe depth. While the battleship, protected by the destroyer is the proper quarry of the submarine, there seems to be no law against sinking the destroyer in passing if her presence were inconvenient.

Personally I am strongly of the opinion that the primary tactical use of submarine will consist in keeping hostile ships fifteen or twenty miles away from the defended place, in preventing them from passing through points at bombarding ranges, and upon occasion forcing such an extension of the blockading line as to make intervals wide enough for the safe passage of a contained fleet or of merchant craft—in short in making blockades non effective no matter what the force employed. That submarines could do this duty within the area defined, seems clear because within that area it would not be war or common sense to expose expensive ships with large crews to the attack of submarines with small crews, when the chances of war were so largely in favor of the boats. The tactical disposition for this primary use has been sufficiently indicated. It would be such that while there would be a certain concert of action, each boat would have to manoeuvre independently under general orders to close and strike when possible.

There exists a considerable weight of authoritative opinion in favor of carrying small hoist-in submarines, aboard battleships and large armored cruisers. Small non autonomous submarines—I mean boats incapable of recharging their storage batteries from motors worked on board—as light as 15 tons weight can be constructed and might have a certain tactical value when a weak fleet had to meet a superior one at sea, since the hoisted-out boats might form a rather comfortable line of defense for the weaker fleet to fight behind, or upon occasion to retreat behind.

But the hoist-out boat does not appeal to me because the

weight and space devoted to boat carriage would considerably detract from the fighting qualities of the battleship under the more frequent conditions of battle. While all other classes of fighting craft should sacrifice efficiency in a particular direction in order to become a better auxiliary to the battleship, not one iota of the latter's power should be reduced in order that she might better aid other types. If a defensive line of submarines were considered useful to a fleet under special conditions, it would seem better to tow a string of coast defense boats by a convoyed steamer. Submarines can be sealed up and towed for any length of time and they tow well and easily without steering. The crews could board them on balsas in a seaway and have them ready for work quicker than the smaller boats could be hoisted out, and could in fact board them in a sea in which the hoisting out of the carried boats would be a slow and difficult if not impossible operation. The idea of hoisting out submarines in the face of the enemy seems ridiculous. It would seem to me too, that for the attack of ships, dry docks, etc., inside a defended port, the towed or self navigating coast defense boat would be much more efficient than the small hoist-in boat.

I would ask you to receive these personal reflections with a large amount of salt, for I am fully aware that my predilection for homogeneity in type of all classes of fighting craft may prevent a proper view of the advantages of two or three kinds of submarines for two or three kinds of work.

With submarines in the defense of a contained fleet the temptation to use them by the containers would be great; for although the defensive submarines could drive off the surface craft of the latter, they could not prevent the containing submarines from closing to prevent the egress of the contained fleet. At present no one knows how much service submarines may be capable of in distant operations; while their proved efficiency shows what may reasonably be expected of them in the coast defense.

Mahan tells us that "Effective defense does not consist primarily in the power to protect but in the power to injure." The submarine surely has the power to injure in her torpedoes and she has sufficient mobility and sufficient invulnerability to make that power felt within the narrow limits of her coast defense work. If we admit that within the twenty miles off shore limit she may be effective, it follows that certain strategic

movements at present considered correct must be broadly modified.

## Strategic Considerations.

From what precedes in the discussion of tactical values, it follows that strategic movements for the purpose of blockade of ports, bombardments of places, or containments of fleets cannot be initiated with confidence of success when there are mechanically effective, well organized and well handled submarines in the defensive and none in the offensive.

Also that submarines would hamper fleets more or less, if they were taken along for deep sea fighting, but as they might be useful as a sort of unattackable and quickly placed mine line to fight behind at sea, their presence or absence would influence strategic conclusions.

In regard to the question of bases for occupation upon a hostile coast, it is apparent that the strategic selection would be modified by the necessity for protection against submarine boat operations—that a base otherwise available would be rendered untenable by the presence of the enemy's coast defense submarines.

For example:—Since deep water channels cannot be held by mines or by gun fire against submarines because mines in any channels practicable for ships can be readily attacked or passed by submarines, movable obstructions or other devices would have to be resorted to to insure a safe defense and this necessity would directly influence strategic selection.

Again, with submarines in the defensive and none in the offensive of a base—which will be the usual condition if submarines cannot be used on extended campaigns—the strategic desirability of multiple exit is lessened, since the containing fleet could be pushed so far off as to make one exit as desirable or more within the limit of effective operation of the boat, i. e., two exits twenty miles apart would be only a very little better than one. Two or more exits so far apart that the distance between them was considerably greater than the radius of effective action of the boats would retain a part of their value assigned them when only surface craft are considered. With submarines in both the offensive and defensive—i. e., under the supposition that submarines can be taken across seas—the multiple exit holds

its value in kind, though less in degree, than when estimated for upon a surface craft basis.

But the chief strategic value of the submarine, the value which nearly all naval services but ours recognises, is the limitation she imposes on coast operations by the enemy in the absence of the home fleet, through her power to meet any class of hostile ship upon the coast by day or night with the chances of success in her favor, and through her power of numbers, due to small cost of construction and maintenance, to cover long stretches of coast.

That country most needs the submarine which has the greatest number of wealth centres that may be operated against in the absence of the cruising fleet and which may be forced to send practically all her fleet abroad.

That country is ours in the opinion of a high English Naval Authority, whom I quote:—

"Let us suppose," he adds, "that in time of war 100 French submarines are let loose in the channel at night. These boats have sufficient speed and radius of action to place themselves in the trade routes before darkness gives place to day, and they will be capable of doing almost incalculable destruction against unsuspecting and defenceless victims. The same possibilities apply to the Mediterranean and to other of our ocean highways within the danger zone of the submarine. The submarine boat has thus increased the value of the mechanical torpedo tenfold. To the United States of America it will be of inestimable benefit, as it will render the coast practically secure against attack from any country excepting those having naval bases within easy striking distance of their littoral."

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

## LETTER FROM HOWARD E. AMES.

SURGEON, U. S. NAVY.

U. S. S. MASSACHUSETTS,
AT SEA,
OCTOBER 5, 1901.

THE SECRETARY AND TREASURER OF THE U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

*Sir:*—In Vol. XXVI, No. 4, of the Proceedings of the U. S. Naval Institute, 1900, is an article, "A Stretcher for Wounded on Board Ship," by Lieut.-Comdr. Dennis H. Mahan, U. S. Navy.

As a matter of history, I send you this for publication.

I designed and have used the same stretcher for the past nine years. The first one made was on the U. S. S. Montgomery in 1893. The second and third on the U. S. S. Detroit in the same year; they were used by me during that whole commission in China and until the Detroit returned to the United States. Straps were first used, but were discarded for a simple lashing, as the straps dragged on the deck, were not tidy, and were trodden upon when used in drill. The coil of lashing was kept in the place assigned for the stretcher. Medical Director Ayers, Fleet Surgeon, Asiatic Station, in his inspection of the ship, commented upon its simplicity.

My idea in designing it was to secure a rigid splint for the whole body, so that no matter what part sustained injury it could be transferred without movement and least discomfort; its narrowness was to admit of its ready transit through watertight doors and small hatches of our modern ships. The but-

tock strip and foot-rest to prevent the sliding of the patient when passed down hatches or into boats.

The simple lashing is preferable to the fixed straps; it can be adjusted to prevent pressure over the seat of injury and variation in size of patients.

The first one of these stretchers I saw other than those I had made is the one now on board this ship; it was brought to this vessel by Dr. Bogert, U. S. N., from the New York. I immediately recognized it, but was surprised and astonished when informed it was called the "Mahan Stretcher." Afterwards I saw an article by Medical Inspector C. U. Gravette, U. S. N., in the Proceedings of the Associations of Military Surgeons, giving Mahan the credit, and later, the article in the Institute Proceedings.

Lieut.-Comdr. John L. Gow lately suggested a valuable improvement in making the buttock strip adjustable to allow for the variation in the length of legs.

Very sincerely,

HOWARD E. AMES,
*Surgeon, U. S. Navy.*

# DISCUSSION.

## Captain Chadwick's Letter Relating to the Training of Seamen.

See No. 98.

Captain Caspar F. Goodrich.—The question with which Captain Chadwick deals is as old as the substitution of steam for sails in the primary motive power of ships. To this question, complete differentiation of labor will, of necessity, furnish the answer to those who look for material results only. Nothing can be more satisfactory than an organization in which each man's task, assigned in exact proportion to his strength and capacity, is performed day in, day out, with ceaseless regularity. Were vessels always to sail under sunny skies over smooth seas, unvisited by tempests and fogs and enemies, such a system would find no serious opponents, scarcely even an adverse critic, except among those perennial shell backs, the *laudatores temporis acti*. They would, indeed, have no real ground for their strictures—not a leg to stand on. As the sailor phrases it; under such circumstances, all the old women would be going to sea.

But, and this seems to me the gist of the whole matter, our organization should not consist exclusively of specialists, helpless in the presence of phenomena different, either in kind or in great degree, from those with which they are habitually concerned; rather should it comprise, in adequate numbers, men of sagacity, boldness, of training and experience in emergencies, when the best of *physique* and *morale* is none too good. It is when the tempest rages or the rock-bound coast, close at hand, is shrouded in a veil of fog, when death looms sudden and awful in a collision, or the lives of fellow human beings hang on the adroit tossing of a rope or the powerful and skillful handling of an oar, when in the thick of battle, men have to think for two and act for six all at once, that any naval system is tested to the breaking point. If we have failed to provide men able to meet these and other exacting contingencies, then we have failed in our duty.

It can hardly be asserted that, hitherto in the history of our navy, the call has not found the right man. If that be so, we must admit that our honorable record has been made by men who got their nautical training in sailing ships. Surely, if experience counts for anything, we should be slow in abandoning the old ways which have confessedly worked so well.

Captain Chadwick would be quite within his logical rights if he simply took the ground that the burden of proof rests, not with him, but with the innovators. He might, very properly, invite them to carefully study the practical and undeniable outcome of the old method and challenge them to show how, in any other way, the man-of-wars-man, that ideally handy man of "courage, resourcefulness, activity, strength," can be better, more rapidly or more economically produced than on board a

sailing ship. Until then, I shall be content to adhere to my convictions, so well expressed by Captain Chadwick, and to endeavor to curb a mild sense of resentment towards those who, in advocating something new and untried, would hold us, of the old school, to a demonstration of the efficacy of its processes, calmly ignoring the fact that the navy is to-day what it is because of what it has been. Paraphrasing a well known epitaph he might say with entire appropriateness, "Si demonstrationem queris, circumspice."

# PROFESSIONAL NOTES.

Prepared by Lieutenant L. S. VAN DUZER, U. S. Navy.

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For convenience of reference these notes are arranged as follows:

A. Notes on ships of war, budgets, and personnel, the notes appearing under the head of the naval power to which they refer. Alphabetical arrangement is followed.

B. Miscellaneous Notes on Armor, Ordnance, Explosives, Torpedoes, etc. The arrangement is alphabetical and the principal heads are:

1. Ammunition.
2. Armor.
3. Boats.
4. Boilers.
5. Canals, Harbors, and Waterways.
6. Coaling Ship.
7. Coast Defense.
8. Communications.
9. Construction.
10. Docks.
11. Electricity.
12. Engines.
13. Fortifications.
14. Fuel.
15. Gunpowder and Explosives.
16. Guns.
17. Guns: Firing.
18. Guns: Mounts.
19. Instruments Used in Action, etc.
20. Machinery (auxiliary engines), etc.
21. Operations (war or manoeuvers).
22. Propulsion.
23. Small Arms.
24. Strategy and Tactics.
25. Torpedoes.

## SHIPS OF WAR, BUDGETS AND PERSONNEL.

### ARGENTINA.

GUNBOATS: BUILDING.—Two gunboats of 709 tons and 17 knots speed are reported to be under construction at Buenos Aires for the Argentine Navy.

BATTLESHIP ORDERED.—On account of trouble with Chili, the Argentine government has, it is reported, ordered, or purchased, a battleship in Europe. The displacement is stated to be 11,000 tons.

### AUSTRIA.

REORGANIZATION OF DEPARTMENT OF MARINE.—It is interesting to observe that the Austrian navy department, which is a branch of the ministry of war, has just been reorganized upon a plan closely resembling that advocated by Lieutenant-Commander John Hood, U. S. N., in last year's prize essay, published in PROCEEDINGS No. 97. While the navy department still forms a part of the ministry of war, it has been formed into an autonomous section under control of a vice-admiral, who is commander-in-chief of the fleet and marine forces, and who will represent the minister of war in the discussions of the budget of the navy department. A superior officer of the fleet will take the vice-admiral's place in case of absence through sickness or other cause.

The Section of Naval Affairs will consist of:

(*a*) The Marine Cabinet: Has charge of affairs reserved from control of bureaus; directs the personnel; issues orders to officers; directs movements of fleets and controls the military service in general; has charge of schools; and controls the hydrographic and medical services.

(*b*) The General Staff: Has charge of plans for war, mobilization, constitution of naval forces, etc.

(*c*) Service I, consisting of—
- Bureau 1. Personnel: officers.
- Bureau 2. Personnel: petty officers and other enlisted men.
- Bureau 3. Administrative matters connected with Service I.

(*d*) Service II, consisting of—
- Bureau 4. Naval construction, machinery, and ordnance.
- Bureau 5. Auxiliary (non-military) vessels, naval works, etc.
- Bureau 6. Administrative matters connected with Service II.

(*e*) Bureaus not belonging to Services I or II—
- Bureau 7. Administration of justice.
- Bureau 8. Administration of funds and accounts in general.

The Cabinet, the General Staff, and Bureaus 1, 2, and 4 are presided over by officers of the General Staff; Bureau 5, by a military engineer; Bureaus 3 and 6, by superior officers of the commissary department; Bureau 7, by an advocate general; and Bureau 8, by a commissary general.

ARPAD: LAUNCH.—The battleship Arpad, 8340 tons, was launched at Trieste, September 11, 1901. The vessels of this class are fully described in PROCEEDINGS No. 97, page 151.

## BRAZIL.

SUBMARINE BOATS.—Much interest is being taken in submarine boats by the Brazilian navy. A naval engineer by the name of Luis Jacintho Gomes recently tested a model of a submarine on the design of which he is reported to have been engaged for ten years. A newspaper of Rio de Janeiro states that the minister of marine has ordered a boat of the Gomes type to be built at the arsenal. Its principal dimensions will be: Length, 20 meters (65.6 feet); beam, 2 meters (6.56 feet); displacement, 40 tons. The propelling power will be an electric motor of 15 horsepower. The armament will consist of several automobile torpedoes. The complement is four men.

A model of a submarine boat designed by Senhor Mello Marques, late lieutenant in the Brazilian navy, is reported to have a successful trial. The model was less than a meter in length and the trials took place in a small experimental basin. The boat is provided with automatic apparatus for keeping the axis in a horizontal plane at all times, and it is submerged and brought to the surface always in this position. A full-sized boat is to be built.

## CHILE.

ALMIRANTE SENORET: LAUNCH.—This small vessel was launched at Valparaiso (or Talcahuano) on October 15. No details have been published.

TORPEDO-BOAT DESTROYERS PURCHASED.—A dispatch from Buenos Aires to the New York Herald, dated December 4, says that the Chilian government has purchased from Messrs. Laird, of Birkenhead, two torpedo-boat destroyers. The purchase price is stated to be £70,000.

## COLOMBIA.

LA POPA: FOUNDERED.—The little Colombian gunboat La Popa foundered on a trip from Savanilla to Cartagena. There was a company of soldiers on board at the time. The only persons saved were four sailors.

## DENMARK.

SINKING OF THE MÖEN.—On September 30, the Danish gunboat Möen was sunk near the Middle Ground, Copenhagen, by the explosion of a high-explosive shell. The vessel was at gun practice with Prisant shells, but the crew was removed before the gun was fired, so that no one was injured. The Möen is an iron gunboat of 400 tons, launched in 1875, and carrying a 10-inch Armstrong muzzle-loading rifle and two Krupp 3.4-inch guns.

## FRANCE.

PROGRAM FOR 1902.—The budget committee of the French Chamber of Deputies has the budget under consideration and it will probably be some weeks before action by the Chambers is taken on all points. The budget committee has declined to sanction any increase of officers or men, though there is an evident shortage of both. It has also refused the small vote asked for commencing work on battleships 12, 13, and 14, the last three of the six provided for in the program, and which were to be laid down this year. The committee says that the small sums asked would be insufficient for any real progress. The minister of marine is therefore unable to prepare plans, make contracts, or do any preliminary work on these ships. Full details of the budget, as submitted by the minister of marine, have been published; but as there are to be so many changes, the compiler defers publication until the amended form is known. As stated in PROCEEDINGS No. 99 (page 588), the total amount of the budget as submitted to the Chambers was 312,097,951 francs ($60,234,904.54; 1 franc = $0.193).

SHIPS COMMENCED IN 1901.—Early in August the minister of marine published a list of all ships commenced during the past year, viz.:

Two battleships: République and Patrie. An armored cruiser: the Victor Hugo. Ten torpedo-boat destroyers: Francisque, Sabre, Dard, Baliste, Mousqueton, Arc, Pistolet, Bélier, Catapulte, Bombarde. Twenty submarines: Naïade, Protée, Perle, Esturgeon, Bonite, Thon, Souffleur, Dorade, Lynx, Ludion, Loutre, Castor, Phoque, Otarie, Méduse, Oursin, Grondin, Anguille, Alose, Truite. Twelve torpedo boats of first class: Nos. 266 to 277.

In addition to these there have since been laid down, or ordered, the armored cruiser $C_{14}$ and three experimental submarine boats.

ARMORED CRUISER $C_{14}$: ORDERED.—The construction of this armored cruiser has been ordered. The original program provided for her building at Cherbourg, but this is changed by the recent order and she will be put on the stocks at the Brest arsenal. She will be a sister ship

in all respects to the Victor Hugo, fully described and illustrated in PROCEEDINGS No. 98, page 384. Her name, it is said, will be either Thiers or Lamartine.

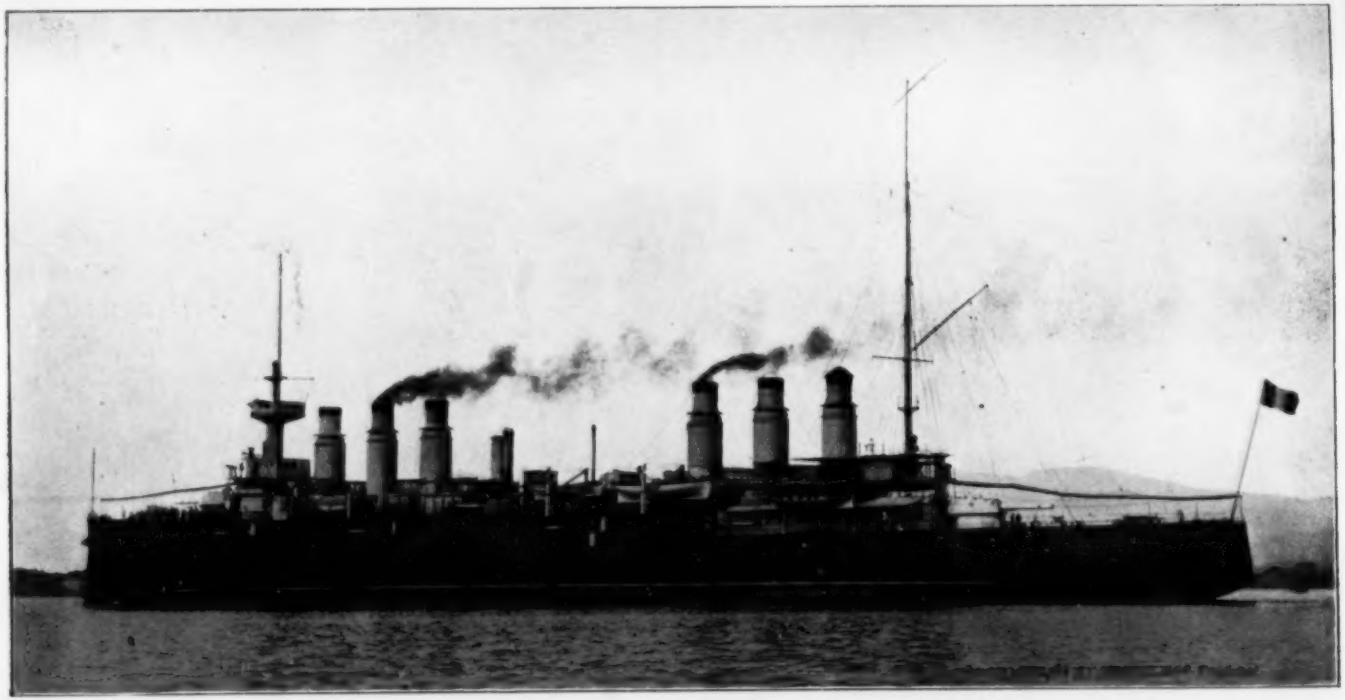
LEON GAMBETTA: LAUNCH.—This first-class armored cruiser was launched at Brest arsenal, October 26. She is a sister ship in all respects to the Jules Ferry, building at Cherbourg, to $C_{14}$, just ordered at Brest, and the Victor Hugo, building at Toulon. The Victor Hugo is fully described and illustrated in No. 98, page 384.

JEANNE D'ARC: UNSATISFACTORY TRIALS.—The trials of this armored cruiser of 11,270 tons have been most unsatisfactory. She was designed for a speed of 23 knots with 1400 tons of coal on board; but, up to the present, a speed of only 18 knots has been reached, although considerably less coal was carried. At full speed the engines are supposed to make 120 revolutions, but at 110 revolutions the bearings heated to a most unusual extent. In addition to these troubles the temperature of the fire-rooms is so high as to be unbearable. A special inquiry is to be held, and it is reported that her boilers may have to be removed and others substituted. The Jeanne d'Arc is fully described in PROCEEDINGS No. 96, page 701, and a full page illustration faces the preceding page in the present number.

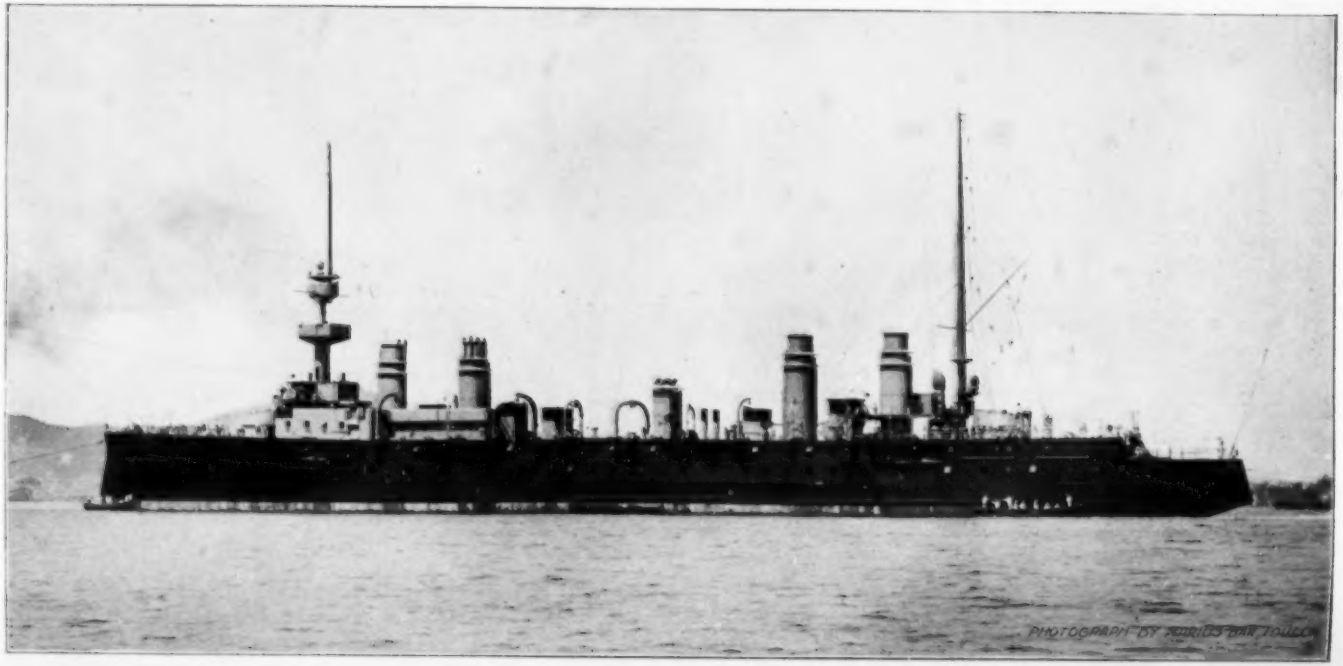
MONTCALM: TRIALS.—This armored cruiser of 9517 tons has completed her preliminary trials and attained a speed of 20.85 knots on the measured base off the Iles d'Hyères. The horsepower developed was 18,200. The designed speed is 21 knots with 19,6000 I. H. P. According to *Le Yacht*, the temperature of the fire-rooms was not abnormal and the machinery behaved in a highly satisfactory manner; but the *Moniteur de la Flotte* states the authorities are much disturbed over the high temperature of the fire-rooms, which was quite intolerable. The Montcalm belongs to the same class as the *Dupetit* Thouars, fully described in PROCEEDINGS No. 97, page 590, from which ship she differs only in her boilers. The latter are of two kinds, 4 of the Normand type and 8 of the double Normand-Sigaudy. The illustration of the Montcalm which faces this page is from a photograph taken during the past summer.

CHATEAU-RENAULT: TRIALS.—The final trials of this protected cruiser of 8018 tons (metric) took place in the latter part of August, and were regarded as satisfactory. The trials consisted of three runs over the measured base with the following results: 1st run, speed 24.043 knots; 2d run, speed 24.324 knots; 3d run, speed 24.067 knots. Mean speed, 24.148 knots. The mean I. H. P. during the trial was 23,680, and the maximum, 24,964. The designed I. H. P. was 23,000, corresponding to a speed of 23 knots. While the trials were regarded as successful, the heat in the fire-rooms was unbearable and no means has been suggested of remedying this defect. The speed that was reached could not have been maintained for any length of time, as the bearings were very hot and growing hotter. It is now proposed to make extensive changes in the machinery bearings in order to reduce the heating, and it is estimated that these changes will take four or five months to complete.

REQUIN: COMMISSIONED.—The coast-defence ship Requin (formerly 7700 tons, now about 7000), which has been undergoing reconstruction



FRENCH ARMORED CRUISER JEANNE D'ARC, 11,270 TONS.



FRENCH ARMORED CRUISER MONTCALM, 9517 TONS.

for several years, is now completed and has been commissioned. The general character of the work on her is described in PROCEEDINGS No. 97, page 159.

VALMY: NEW LOADING APPARATUS.—M. Guye, *chef d'escadron d'artillerie de marine*, has devised mechanism for the loading of heavy guns, which has been applied to the Valmy's 340-millimeter (13.4-inch) with the result that the time of loading has been much reduced. The interval between unaimed shots was formerly 4 or 5 minutes, but in a recent trial, with the new apparatus, five shots were fired in a little less than four minutes.

INDOMPTABLE: RECONSTRUCTION COMPLETED.—The coast-defence ship Indomptable (formerly 7500 tons, now 500 or 600 tons less), of the same general type as the Requin, is now nearly ready for service after extensive repairs and reconstruction. The alterations effected consisted principally in replacing the old cylindrical boilers by others of the same type and of substituting new model guns of 274.4 millimeters (10.8-inch) gun in closed turrets for the old pieces of 420 millimeters mounted in barbettes. The new turrets are operated by electricity or by hand.

BOURRASQUE: LAUNCH, SEA SPEED, DESCRIPTION.—The Bourrasque was launched at the works of Messrs. A. Normand & Company, Havre, August 31. It belongs to the group of four boats, consisting of the Borée, Rafale, Tramontane and Bourrasque, which boats are a development of the Siroco type. They are of 19 tons less displacement and, with 200 more horsepower, were expected to give 3 or 4 knots more than the contract requirement of the Siroco class, or about 2 knots more than they made on trial. The reduction of displacement is effected by reducing the dimensions and lightening the construction. The length is 147.6 feet; beam, 15.68 feet; drauft aft, 8.0 feet; displacement, 161.9 tons. The coal supply is 18 tons; radius of action, 2000 miles at 10 knots; expected speed, 29 to 30 knots with 4400 I. H. P. Two torpedo tubes and two 3-pounder guns constitute the armament. On a trip from Havre to Cherbourg, where she was to go for her trials, the average speed was 27 knots for 2 hours and 20 minutes.

SIMOUN: TRIAL, DESCRIPTION.—The torpedo boat Simoun, 181 tons, of the Siroco type, has completed her trials, attaining a speed of 27.7 knots. The contract requirement was 26 knots. The following description of the boats of this class is from the London *Engineering* of October 25:

"MM. Augustin Normand and Company, of Havre, have recently delivered to the French Government, at Cherbourg, two protected torpedo boats, the Siroco and Mistral, fitted with the same machinery and boilers as the Cyclone. The trials offer special interest on account of the very heavy weights carried. The dimensions are:

| | |
|---|---|
| Length on load line | 147 ft. 0 in. |
| Extreme breadths outside armour | 16 ft. 10 in. |

"The nickel steel armor extends to the machinery and boiler compartments, and is distributed as follows:

| | |
|---|---|
| 24-Millimetres (1-in.) bare | Vertical sides from 8 in. below the water-line to the deck.<br>Fore-and-aft bulkheads from 16 in. below the water-line to the deck.<br>Vertical sides of coverings of all parts of machinery and boilers and of the steering engine above deck. |
| 9-Millimetres ($\frac{1}{4}$-in.) bare | All horizontal parts of deck and hatchways. |

"The total extra weight resulting from the addition of armor—including the strengthening of the hull amidships, and the addition of a central hollow keel 1 ft. high, extending to about one-half the length of the boats, and intended to stiffen the central part of the structure, and to check rolling—is not less than 24 English tons.

"The hulls are very strong, as was proved by an accident which occurred to an exactly similar protected torpedo boat in a trial outside Lorient. When steaming at about 23 knots, during foggy weather, she ran end-on against a rock rising above water; and although several men were injured by the shock, no material damage, beyond the crushing of about 25 ft. of the fore part, occurred to the boat, which was towed back to harbor.

"The total other weights carried on trial, exclusive of chains, anchors, masts, boats, &c., and comprising only torpedo tubes and compressing pump, artillery and ammunition, provision water for boilers and crew, coals necessary for steaming 1020 nautical miles at 14 knots, crew and effects, provisions, including 5 tons for sundries to complete displacement at sea, amounted to 39.9 English tons in the Siroco and 43.2 tons in the Mistral. Accordingly, the displacement on trial: 177.5 English tons for the Siroco and 178.7 tons for the Mistral, was that of the boats on service.

"It has very wisely been the general custom of the French Admiralty to have the trials of ships made at what was believed to be full load; but lately this rule has been enhanced, as it was ascertained that these full-load trial displacements were often inferior to the real displacement on service.

"If the 24 tons due to armor are added to the above weights, we see that the total weights carried on trial amount to 63.9 and 67.2 tons respectively; that is to say, to about 37 per cent. of the total displacement. This is far from the 35 tons carried on board destroyers of much larger displacement. The weight of coals put on board was determined by an eight hours' preliminary trial.

"The full-speed trials, which took place after the ordinary preliminary runs on the measured mile, were of four hours' duration, one hour of which was to be run at 22 knots, one hour at maximum speed, and the next two hours at 22 knots.

"The one-hour maximum speed was found to be 28.341 knots for the Siroco and 28.102 knots for the Mistral. Only 26 knots were due according to contract. The maximum speed of the Cyclone (unprotected), with a displacement of 141 English tons, was 30.7 knots.

"It is generally admitted that great speed can only be attained by reducing all weights to, and even beyond, their extreme limits. That is, no doubt, true to a great extent. However, from the above results, which may be said to be extraordinary on account of the unusual importance of the deadweight carried, there seems good reason to believe that not only sufficient strength but a very complete armament, and even

some protection, may be given to torpedo-boats and destroyers without an abnormal reduction of speed."

TRAMONTANE: TRIALS.—This torpedo boat of 162 tons, a sister to the Bourrasque, which is fully described on a foregoing page of this number, has completed her trials. On the 3-hour trial at reduced power the speed was 23 knots with 290 revolutions. On the one-hour full power trial the mean speed maintained was 29.8 knots with 339.57 turns.

TROMBE: TRIAL SPEED.—The torpedo boat Trombe, which was seriously injured by running on a rock during her first trials, has been repaired and has completed her trials. The speed maintained during the one-hour full-power trial was 26.6 knots, 0.6 knots in excess of the contract requirement. The Trombe is a sister boat in all respects to the Audacieux, fully described in PROCEEDINGS No. 97, page 157.

TORPEDO BOATS NOS. 253 AND 254: LAUNCH; TRIAL OF NO. 253.—These two boats, which are alike in all respects, are under construction at the yard of Messrs. A. Normand & Company, Havre, where No. 253 was launched on August 16 and No. 254 on September 27. The dimensions of the boats are: Length, 121.4 feet; beam, 13.78 feet; draught aft, 8.6 feet; displacement, 90.2 tons. The designed speed is 24 knots with about 1800 I. H. P. On her one-hour full-power trial in October, No. 253 developed a speed of 25.36 knots with 340.5 revolutions.

TORPEDO BOAT NO. 258: TRIAL SPEED.—This torpedo boat was built at the yard of the Ateliers et Chantiers de la Gironde, Bordeaux. On the one-hour full-power trial the mean speed maintained was 25.56 knots, 1.56 knots in excess of the requirement of the contract. No. 258 is very similar to Nos. 253 and 254 but is 1.6 feet longer.

TORPEDO BOAT NO. 259: LAUNCH.—This torpedo boat is similar in all respects to No. 258, and is building at the yard of the Gironde Company, where it was launched October 2

EXPLOSION OF A BOILER IN TORPEDO BOAT NO. 208.—After going through speed trials with the other boats of the *defence mobile* of the port of Algiers, No. 208 was returning to the anchorage when a tube of one of the boilers suddenly gave way while the boiler was being fired. In turning off the steam, quartermaster Kernec was mortally injured. Two of the firemen were so badly burned that they are likely to die and two others burned in a less severe manner.

SILURE: LAUNCH.—This submarine boat of the submergible type was launched at Cherbourg arsenal October 29, 1901. She is similar in all respects to the Sirène, fully described in PROCEEDINGS No. 98, page 387.

ESPADON: LAUNCH, TRAILS.—The submarine boat Espadon, a sister to the Silure (see preceding paragraph), was launched at the Cherbourg arsenal October 31. About a month later she made her first trial plunge, which continued four hours. The trial is reported to have been satisfactory in all respects. The speed obtained (probably when running on the surface) was 8.7 knots with 380 revolutions. With maximum power the expected speed is 10 knots with 420 revolutions. Later, a second

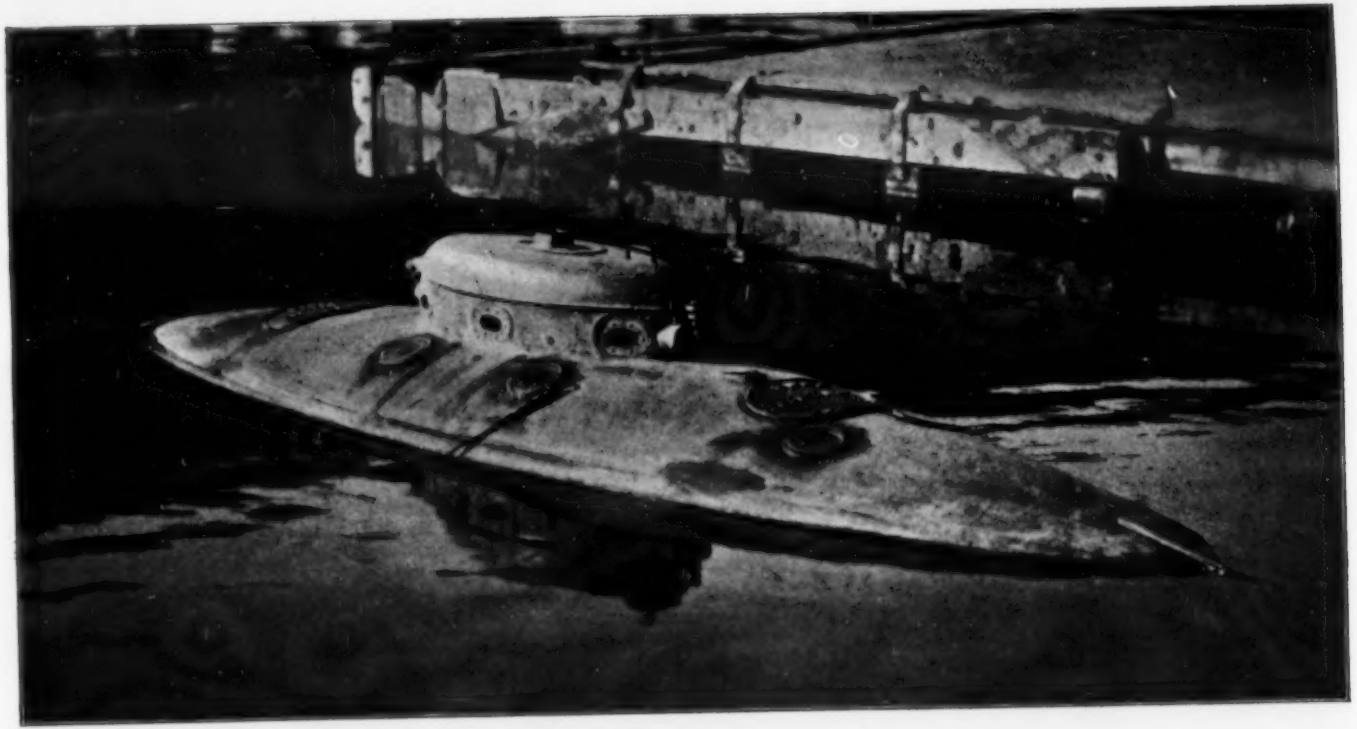
plunge of two hours and a half was made. The time required to submerge to a depth of 9 meters (27.5 feet) was a little less than 8 minutes. As these results were considered very satisfactory the preliminary trials were declared finished.

SIRÈNE: TRIALS.—This submarine boat (fully described in PROCEEDINGS No. 98, page 387) of the submergible type has recently completed her trials and orders have been issued for her to be manned and equipped for service. In an endurance test of 24 hours the speed for three hours at the surface was 7.5 knots; then a plunge for three hours was made (speed not given); then a surface run of 17 hours at a speed of 7.5 knots; and lastly a plunge of one hour during which two torpedoes were launched. The Sirène has a radius of action of 500 miles at 7 knots, which is regarded as ample. The greatest advance made on the design of the Narval, her prototype, is in the time of effecting submersion, which has been reduced from 20 minutes to 9.

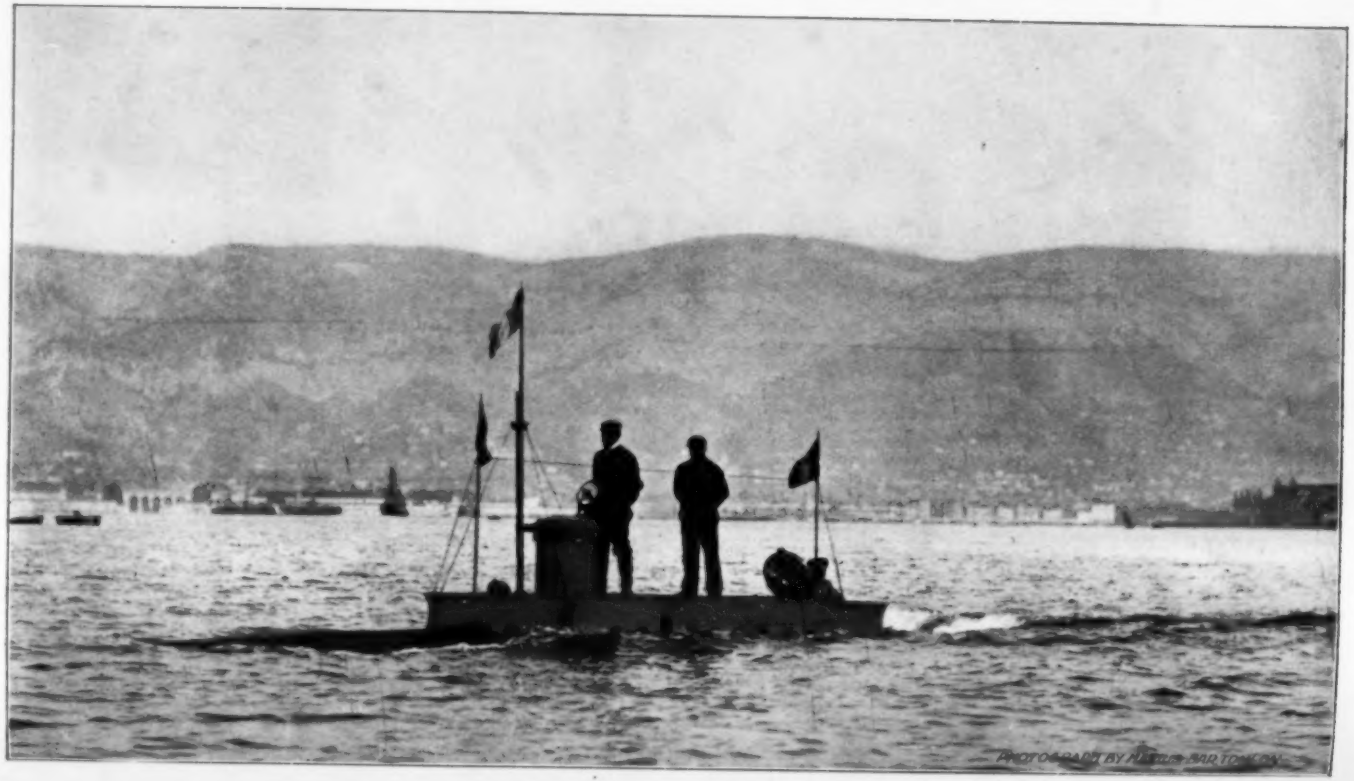
TRITON: ACCIDENT.—"A serious accident to the French submarine Triton, at Cherbourg, is reported by The Express. It appears that the vessel plunged too rapidly, struck bottom and sustained considerable damage. Water began to flow in very rapidly, but the engineer ordered the detachable weights to be cast adrift and the boat rose to the surface, though none too soon. The pumps were got to work on the surface and a tug pulled the vessel into the arsenal."—*Army & Navy Journal*, Nov. 23, 1901.

GOUBET NO. 2: DESCRIPTION; REJECTION BY FRENCH GOVERNMENT.—This is the second type boat constructed by M. Goubet. The shape of it is very different from that of the other submarines. The cross-section is circular; the general shape being that of a double ogival with bases joined. Above the center rises the conning-tower, and below the center a heavy weight (1.5 tons) acts as a keel, a steadying weight, and safety ballast—as it can be detached if necessary to assist the boat to come to the surface. The hull is of bronze, cast in three pieces, which are joined by outside flanges; and it weighs 5 tons. The shell of the middle section has a thickness of 1 inch; the end sections taper from 1 inch to 0.625 inch at the extremities. The ballast consists of the outside safety weight, or keel, 7 tons of lead ballast, and 2 tons of water ballast. Like all the French boats, the Goubet is fitted with an observation tube extending above water. The armament consists of two torpedo tubes. The propelling power is an electric motor driving a single screw. The electricity is furnished by storage batteries. The speed attained was about 5 knots and the radius of action is about 25 miles. The principal dimensions are: Length, 26.25 feet; diameter, 9.84 feet. The illustration which faces this page is from a recent photograph taken at Toulon. The trials of the Goubet have shown fairly successful results, but she was too slow, and of deficient radius of action. The following note appears in the London *Engineering* of October 18, 1901:

"*Le Yacht* states that M. Goubet has received instructions from the French Ministry of Marine to remove his submarine boat Goubet No. 2 from the arsenal at Toulon, which is tantamount to a rejection of the boat by the French Government. The journal adds that the experiments with the boat have proved that she is habitable, stable, absolutely immo-



FRENCH SUBMARINE BOAT GOUBET, No. 2.



FRENCH SUBMARINE BOAT GYMNOTE.

bile at any depth, can float, can be rapidly submerged and brought to the surface again, displays an unequalled facility in her evolutions and in the maintenance of her line of route, and finally an assured security due to her "safety weight" and the ease with which she can rise to the surface in the case of danger. In the experiments of April 19 and 24, 1900, she showed that she could face with safety a high wind and a heavy sea. It is proposed, *Le Yacht* states, that the principle of her construction shall be used in building a submarine vessel for crossing the Channel, by means of which passengers would avoid the terrors of *mal de mer*."

GYMNOTE: DESCRIPTION.—The plans of this boat were submitted in October, 1887, by the Forges et Chantiers de la Mediterranée, and accepted by Admiral Aube, then minister of marine. The designer was M. Zédé, engineer of that company. The boat was built under the supervision of M. Romazotti at the Mourillon dockyard, Toulon, where she was launched on September 15, 1888. The hull is of steel and its shape is similar to that of a Whitehead torpedo. Like the Whitehead, the Gymnote has two horizontal rudders worked by hydrostatic pressure, or by hand, and two vertical rudders worked by the usual appliances. The forward and after ends of the boat are used for water ballast and are filled or emptied by an electrically driven pump. The crew of the Gymnote consists of four or five men, including the commanding officer. The enclosed air would last for several hours for four or five men, but there is no provision for its renewal, as the compressed air reservoir was intended solely for launching the torpedoes and operating the rudders. This boat, like the Goubet and later French boats, was fitted with a tube which projected above the surface of the water and held in its upper end a small mirror about an inch in diameter, set at an angle of 45 degrees to the horizon, and movable about its vertical axis so that the whole horizon could be seen from the inside of the boat, provided of course, that the waves or spray did not destroy the reflecting power of the mirrors. The Gymnote, like the previously-built boats, does not possess good fore-and-aft stability when submerged. When, by outside influence, the bow becomes depressed, the vessel shoots ahead in the direction thus impressed upon it, and some little time elapses before the horizontal rudders act with sufficient force to counteract. When these at last get control and guide her upward, the same performance is repeated, so that she is constantly pitching to every wave in a very unpleasant manner. When moving at a depth below water greater than a few feet, the observation tube is of course useless, and the instability of the boat when at the surface render it of little value. The armament consists of dropping gear for torpedoes. The motive power consists of a single screw driven by an electric motor, which is the invention of Captain Krebs of the balloon service. It consists of 16 poles arranged around a ring armature one meter in diameter. Its weight is 4400 pounds. The propeller is 4-bladed and 4.8 feet in diameter. The motor is direct-coupled to the screw and is designed for a speed of 200 turns per minute. The estimated surface speed was 10 knots for 6 hours, but this has never been reached, about 8 knots being the maximum. The boat is steered, propelled, and lighted by electricity, which is supplied by a battery of 564 alkaline accumulators, invented and manufactured by MM. Commelin, Desmazures, and Bailhache. Each accumulator weighs 38.5 pounds, so that the weight of the whole battery

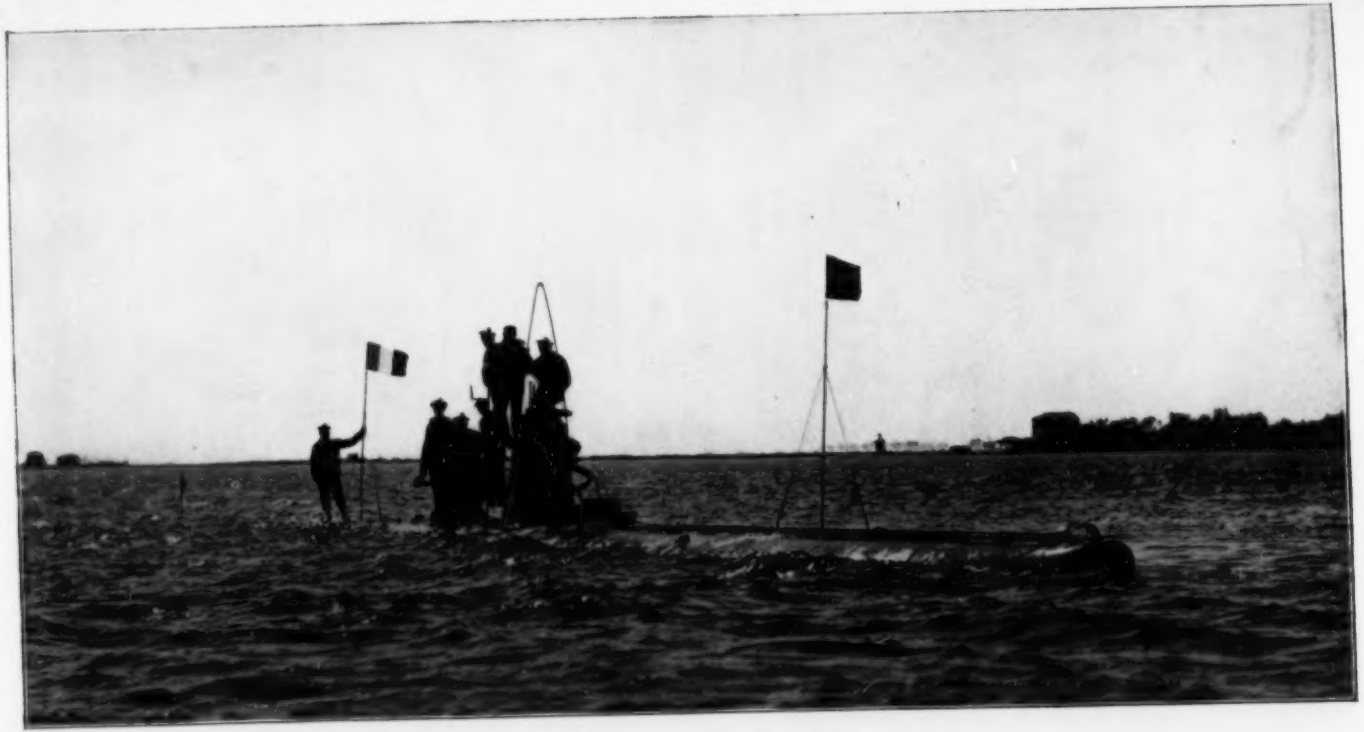
is 9.66 tons. The total power of the battery is 345 horsepower hours and gives about 60 horsepower with the normal current of 220 amperes at 220 volts. The dimensions of the hull are: Length, 59 feet; greatest diameter, 5.9 feet; displacement when fully submerged, 29.5 tons. The illustration which faces this page is from a recent photograph taken at Toulon.

GUSTAVE ZÉDÉ: DESCRIPTION.—The Gymnote was unsatisfactory in many ways. The means of discharging her torpedoes were inadequate to the necessities of the case and she was well-nigh uninhabitable for more than an hour or two. In addition, the speed was insufficient and it was found practically impossible to keep her on an even keel. It was generally conceded that her defects were largely due to her small dimensions; therefore, in 1892, M. Zédé designed a larger vessel which was to be called the Sirène, but was renamed Gustave Zédé upon the death of her designer. She is much larger and of a more slender model than her predecessor, and many of the serious defects of the latter were corrected or minimized. The rising and sinking is effected by means of water ballast, but she also possesses horizontal rudders to correct any tendency to dive or rise abruptly. Two tanks furnish the compressed air for launching the torpedoes as well as for supplying fresh air for breathing; and the foul air is drawn out by an electrically driven pump. The armament consists of a single torpedo tube, and three torpedoes are carried. The motive power is electricity supplied by a Laurent-Ceby storage battery to a 760-horsepower Sautter-Harlé motor, which drives a single screw. It is reported that a speed of 15 knots has been made when running on the surface at light draught, and 8 knots when nearly submerged. Her submerged speed is about 6 knots. The hull is of bronze, designed for strength sufficient to descend with safety to a depth of 60 or 70 feet, and is of the following dimensions: Length, 147.5 feet; diameter, 10.8 feet; displacement when fully submerged, 260 tons. The complement is 9 persons. The trials of the Zédé have been numerous and extensive, but the information which has reached the public is rather indefinite. Various reports of inhabitability, due to foul gases generated by the storage battery, appeared from time to time, but it is believed that this difficulty has been surmounted. The great relative length renders the Zédé very unhandy, and this was one of the causes for the reduced dimensions of the later submarines. The illustration is from a recent photograph taken at Toulon.

BAYARD, GALISSONNIÈRE, TURENNE, EURE, NAUTILE, TORPEDO BOATS LANSQUENET, AND NOS. 26, 38, 42, 53, 91, 113, 118, 119 AND 124: CONDEMNED, LOST, OR STRUCK FROM LIST.—The Bayard (old type battleship of 6000 tons) has been dismantled at Saigon, as no money was allotted in the budget for her maintenance. The Galissonnière and Turenne (practically sister ships to the Bayard) are to be sold; as are the torpedo boats, Lansquenet and Nos. 91 and 113. Torpedo boats Nos. 26, 38, 53, the gunboat Nautile, and the transport Eure have been struck from the list of the fleet. Torpedo boats Nos. 42, 118 and 119 have been condemned. Torpedo boat No. 124 was lost in the Mediterranean on September 17 and lies in such deep water that she cannot be recovered.

## GERMANY.

BUDGET AND PROGRAM FOR 1902.—The budget proposals for 1902, which have not yet been passed upon by the Reichstag, call, it is said,



FRENCH SUBMARINE BOAT GUSTAVE ZÉDÉ.

for the construction of seven battleships, two large cruisers, three small cruisers, a continuation of the rebuilding of the ships of the Siegfried type, and a torpedo division; and the cadet ship Gneisenau, which sank near Malaga in December last, is to be replaced by an old cruiser reconstructed for the purpose. It is reported that the German naval authorities have decided to build a torpedo-boat destroyer fitted with Parsons' steam turbines with a view to testing that form of motor.

EDUCATION OF GERMAN OFFICERS.—From an article in the Marine Rundschau we learn that the present regulation in regard to the training of officers was issued in April, 1899. In 1893 regulations were issued which provided that after going through a four weeks' course of training on shore, the cadets joined the training ship until the spring of the following year; the ship, as a rule, cruised in home waters during the summer and passed the winter abroad, in the Mediterranean or West Indies, returning home in the following spring. After passing the examination for, and promotion to, midshipman, they embarked for another full year's course of practical training on one of the cadet and boys' training ships. On these ships, which also went abroad in the winter, theoretical and practical instruction was imparted, terminating with an examination at the end of the voyage. Those midshipmen who passed the examination were sent for a six months' course of purely practical duty on the ships of the evolutionary squadron, and then for a year to the naval academy. After passing the lieutenant's examination (Seeoffizierprüfung), promotion to sub-lieutenant (Unterlieutnant zur See) followed.

The regulations of 1899 changed the program of instruction. After the practical training of one year on board the training ship the theoretical training as naval ensign (Fähnrich zur See—formerly See Kadett), he is again transferred to the naval academy. At the close of the academy course the principal examination for line or executive officer (Seeoffizier) takes place, and the ensign is then sent for half a year to the gunnery and torpedo ships and to the marine infantry for special practical and theoretical courses in gunnery, torpedo, and infantry instruction. Each of these special courses is followed by an examination which has a bearing on the result of the examination for the rank of lieutenant. After completing these special courses, those ensigns who pass the examinations are sent for two years' further practical training on board battleships or large cruisers. The theoretical training ceased with the previously mentioned examination. At the end of the first year promotion follows to lieutenant (Lieutnant zur See, formerly Unterlieutnant zur See), and the seniority is determined.

At the naval academy instruction is given in the following subjects:

(*a*) Navigation, naval tactics, seamanship, gunnery and torpedo instruction, knowledge of ships' machinery, and of ships and their construction, mathematics, physics, English and French.

(*b*) Knowledge of duties, mining, land tactics, fortification, and drawing.

BATTLESHIPS H AND I: DESCRIPTION.—These battleships, as stated in PROCEEDINGS No. 99, page 599, are building at the Germania yard, Kiel, and the works of Herr F. Schichau, Dantzic, respectively, and are of a modified Wittelsbach type. The estimated cost of each ship is 24,860,000

marks ($5,916,680; 1 mark = $0.238). Of this sum, 16,650,000 marks is allotted to the hull, machinery and armor; 7,500,000 marks for guns, mounts, etc.; and 710,000 marks for the torpedo armament. The principal details are:

*Armament.*—Four new-model 280-millimeter (11.02-inch) guns of the so-called rapid-fire type (firing every 90 seconds according to German semi-official statements); eighteen new-model 170-millimeter (6.68-inch) rapid-firing guns; a large number of small pieces; and several torpedo tubes.

*Protection.*—Somewhat similar to that of the Wittelsbach class (see PROCEEDINGS No. 97, page 160), but covering a greater proportional area of the side.

*Motive power.*—Speed the same as that of the Wittelsbach class, 19 knots.

*Dimensions.*—Displacement, 13,000 tons.

SCHWABEN (EX-G) AND MECKLENBURG (F): LAUNCH.—These two battleships have been launched, the former at the imperial dockyard, Wilhelmshavn, August 19, and the latter at the Vulcan Works, Stettin, November 9. They are similar in all respects. The Schwaben (ex-G) is fully described in PROCEEDINGS No. 97, page 160. As the keel of the Schwaben was laid December 1, 1900, the speed of construction has been excellent.

KAISER BARBAROSSA: TRIALS.—This battleship has completed her trials in a satisfactory manner. The vessels of her class are fully described in PROCEEDINGS No. 98, page 388, and a full page illustration of one of them, the Kaiser Friedrich III, faces page 389. The propelling machinery and boilers are not the same in all the vessels of the class; but, except as regards boilers, the differences are immaterial. The engines of the Barbarossa are triple-expansion and three in number, each having cylinders of 35.4, 57.5, 61.4, and 61.4 inches diameter by 37.4 inches stroke. The boilers are of two kinds: six cylindrical boilers in the after fire-rooms with a total grate area of 505.9 square feet and a heating surface of 16,792 square feet; and six Thorneycroft water-tube boilers in the forward boiler rooms with a total grate area of 413.4 square feet and a total heating surface of 23,929 square feet. Both types of boilers have a working pressure of 192 pounds per square inch. The side screws have each three blades, are each 14.76 feet in diameter, and have a pitch of 19.69 feet. The middle screw has four blades, is 13.78 feet in diameter and has 19.77 feet pitch. The designed number of revolutions is 110 for each screw. The results of the trials are as follows:

| | Endurance Trial. June 25-27. | Full Speed Trial. July 5. |
|---|---|---|
| Mean draught at beginning, feet | 25.66 | 25.62 |
| Mean draught at end, feet | 24.47 | 25.36 |
| Duration of trial, hours | 50. | 6. |
| Revolutions, mean of all screws, per minute | 94. | 112.8 |
| Coal per I. H. P. per hour, mean engines, lbs. | 1.83 | —— |
| Indicated horsepower, total | 7,360. | 13,940. |
| Air-pressure, water-tube boilers, inches | 0.0 | 2.05 |
| Air-pressure, cylindrical boilers, inch | 0.0 | 0.45 |
| Speed, knots | 15.5 | 18. |

ARIADNE: TRIAL.—The following details of the Ariadne's trial appear in the *Journal of the American Society of Naval Engineers*, translated from the *Marine Rundschau:* Duration of trial, 6 hours; mean draught, 15.32 feet; air-pressure in inches of water, 1.7; I. H. P., 8827; revolutions per minute, 168; speed, 22.18 knots. The Ariadne is a protected cruiser of 2645 tons and is a sister ship in all respects to the Amazone, fully described in PROCEEDINGS No. 96, page 703.

WACHT: SUNK IN COLLISION.—On September 14, the small cruiser Wacht (1253 tons, 4000 I. H. P., 20 knots, launched in 1887) collided with the battleship Sachsen. She was taken in tow by the Weissenburg, but a few minutes later she had to be abandoned and shortly afterwards sank. The officers and crew were all saved.

AEGIR: BOILER ACCIDENT.—A boiler tube gave way on the coast defence ship Aegir (3550 tons) recently, injuring four firemen. The boiler was of the Thorneycroft type. No details have been published.

TORPEDO BOAT $S_{107}$: LAUNCH, DESCRIPTION.—Torpedo boat $S_{107}$, the last of the torpedo boat division under construction at the Schichau Works, Elbing, was launched on October 21. This is the eighteenth boat of the new large type (they are of the size usually denominated torpedo-boat destroyers) built at the Elbing Works. The armament consists of five 50-millimeter (1.97-inch) rapid firing guns and three training torpedo tubes. The engines are twin-screw, of 5500 to 6000 I. H. P., and are designed to give a speed of 27 to 28 knots. The dimensions are: Length, 200.1 feet; beam, 24.9 feet; draught, 8.53 feet; displacement, 350 tons.

TORPEDO BOAT $G_{108}$: LAUNCH.—This boat is the first of six ($G_{108}$ to $G_{113}$) building at the Germania Works, Kiel, where she was launched September 7. The details are practically identical with those of $S_{107}$ given in the preceding paragraph.

TORPEDO BOAT HARBOR.—There is to be constructed at Kiel, near the entrance to the Baltic-North Sea Canal, a harbor of sufficient capacity to afford berths for sixty torpedo boats. Barracks to accommodate the crews of thirty boats (about 1600 men) will be built on shore.

## GREAT BRITAIN.

BUDGET AND PROGRAM FOR 1902-03.—The Admiralty officials are reported to be at present (Nov. 20) engaged in preparing the budget and program for next year. It is believed that the estimates for new construction will be less than usual on account of the heavy expenditure for the South African War.

BELLEISLE: PREPARED FOR NEW TRAILS.—See "Guns: Firing," page 830.

AMMUNITION SUPPLY OF NEW BATTLESHIPS.—It is said that the Admiralty has fixed the ammunition supply per gun for the new battleships at 90 rounds of 12-inch, 200 rounds of 6-inch, and 200 to 300 rounds of 12-pounder (3-inch).

EXMOUTH: LAUNCH.—The first-class battleship Exmouth, 14,000 tons, was launched at the yard of Messrs. Laird Brothers, Birkenhead, August 31, 1901. Her keel was laid August 10, 1899. She is a sister ship in all respects to the Albemarle, Russell, and Montagu, fully described and illustrated in PROCEEDINGS No. 97, page 167.

KING ALFRED: LAUNCH.—The first-class armored cruiser King Alfred, 14,100 tons, was launched at the yard of Messrs. Vickers' Sons and Maxim, Barrow, October 28. Her keel was laid August 11, 1899. She is a sister ship in all respects (including boilers) to the Leviathan, fully described in PROCEEDINGS No. 99, page 602.

BEDFORD, ESSEX, MONMOUTH: LAUNCH.—These first-class armored cruisers of 9800 tons have all been launched—the Bedford at the yard of the Fairfield Shipbuilding Company, Govan, August 31; the Essex at the government yard, Pembroke, August 29; and the Monmouth at the yard of the London and Glasgow Company, Glasgow, November 13. They are sister ships in all respects to the Kent, fully described in PROCEEDINGS No. 96, page 696.

HYACINTH AND MINERVA: TRIALS.—The trials of these ships, which were made to give a comparative test of their boilers, are fully described under the head of "BOILERS," page 788.

SPARTIATE: READY FOR TRIALS.—This protected cruiser, whose trials have been suspended for more than a year, pending extensive repairs and alterations, is reported to be again ready for trial.

ESPIÈGLE: TRIALS.—This gunboat of 1075 tons has recently completed her trials with the following results:

| Date of Trial. | Duration, Hours. | Steam at engines, lbs. | Vacuum, inches. | Revolutions. | Air-pressure, inches. | I. H. P. | Coal per I. H. P. lbs. | Speed, knots. |
|---|---|---|---|---|---|---|---|---|
| July 24–25 | 30 | 203 | 26.5 | 124.9 | nil. | 337 | 1.53 | 10. |
| 27–28 | 30 | 198 | 26.5 | 179·1 | nil. | 1029 | 1.54 | 12.5 |
| 30 | 8 | 198.9 | 26.8 | 199.1 | 0.2 | 1425 | 1.69 | 13.5 |

The Espiègle is fully described in PROCEEDINGS No. 97, page 169. Though designed for Belleville boilers, as there stated, she was subsequently fitted with boilers of the Babcock & Wilcox type. The machinery was built by the Wallsend Slipway and Engineering Company. The trials passed off without incident and were successful in all respects. The first two were for the purpose of determining the coal consumption at different speeds and observing the working of the machinery and boilers. The third was the full power trial.

IMPLACABLE: SINKING OF THE BARBETTES; ENGINE DIFFICULTIES.—It is reported that one of the barbettes of the Implacable has sunk 6 inches. The *Engineer* (London) says that this occurred through moving the gun in dock, and, as the ship did not happen to be supported directly beneath the barbette, the latter sank; that the difficulty was remedied by cutting off the base of the cone which supports the barbette; and further, that the repairs took exactly one day. It is possible that the sinking is unimportant, but the statements just quoted are rather surprising. How a failure to support the ship underneath the barbette could occur seems

remarkable. There ought to be at least half a dozen keel blocks taking this weight. That the difficulty was remedied by cutting off the base of the cone (*i. e.* the supporting structure) seems no less remarkable. There is no such thing as a cone below the barbette walls; there may be a cylinder or rectangular framing—probably both. If the facts are as stated, there must have been, of course, a great bulge in the ship's bottom; while the transverse frames, longitudinals, and bulkheads must be much bent, buckled, and sprung out of shape. How could all this be repaired in a day? In addition to the troubles mentioned, the Implacable has had some with her machinery. She had three unsuccessful trials, at four-fifths power, on account of hot bearings; and on September 22 she returned to port with her engines broken down after having been out one day.

EURYALUS: ACCIDENT.—While this cruiser was in drydock, on August 24, some of the supporting shores buckled and broke. This led to the giving way of others, and finally the vessel toppled partly over. It appears that the injuries caused are very serious. The bottom is much deformed; many of the boilers are injured and all will probably have to be removed. The sheathing over nearly the whole bottom will have to be renewed as well as some of the plating, and some of the frames will need reforming.

POWERFUL AND TERRIBLE: ADDITIONS TO BATTERY.—These large protected cruisers of 14,200 tons have always been considered to be inadequately armed for ships of their size, especially as they have no armor except that of the 6-inch casemates. It is now proposed to add four casemates, each containing a 6-inch gun. They are to be placed on the gun-deck, one over each of the four midship casemates. This will make all of the casemates double-decked like those of the Drake class.

PROMETHEUS: TRIALS OF SCREWS.—The protected cruiser Prometheus (2135 tons, 7200 I. H. P., 20.5 knots) is to undergo a series of trials with different screws to determine the best design for ships of her class. The first trial will be made with those now fitted and will consist of runs on the measured mile at speeds of 15 to 20 knots. A second trial of a similar kind will be made with screws of greater pitch. She will then be fitted with others of a new type and tried again.

MOORHEN: LAUNCH, TRIALS.—This shallow-draft gunboat of about 180 tons was launched at the works of Messrs. Yarrow and Company, Poplar, August 13. On August 21, she had her official trials. The guaranteed speed of 13 knots was maintained for three hours with open fire-rooms and without using forced draft. During one hour wood fuel alone was used. The speed trial was made while on the way to Sheerness, and for more than two-thirds of the time she steamed against a 25-knot breeze. The Moorhen is a sister ship in all respects to the Teal, which is fully described and illustrated in PROCEEDINGS No. 99, pp. 581 and 603.

ASSISTANCE: COMPLETED.—This vessel is fitted as a repair ship, or floating workshop. She is also fitted with evaporating apparatus sufficient to supply 150 tons of water per day. She was recently completed at the yard of Sir Raylton Dixon and Company, Sunderland, and is to

be attached to the Mediterranean Squadron. The dimensions are: Length, 436 feet; beam, 53 feet; draught, 20 feet; displacement, about 9600 tons. The machinery is of 4200 I. H. P. with forced draft, and 3000 I. H. P. with natural draft. The corresponding speeds are 13 and 12 knots. She will have a 3-pounder gun for signal purposes and will be fitted with apparatus for wireless telegraphy. The complement is 262 officers and men.

TORPEDO-BOAT DESTROYERS: NEW TYPE UNDER CONSIDERATION.—"The British Admiralty has obtained expressions of opinion from leading builders of torpedo-boat destroyers with regard to certain contemplated changes to economize weight and facilitate repairs on vessels of that type. Several destroyers are soon to be built, and it is intended not only to give them increased size and seaworthiness, but also to enlarge their radius of action by providing for larger coal capacity even at the expense of speed. In something like half of the 100 of these boats which have been added to the British fleet within the last three years the speed rate was 30 knots or over, reaching 32 in the Arab, 33 in the Express, 35 8-10 in the ill-fated Cobra and 36 58-100 in the Viper. In the boats now in contemplation the maximum rate will be only 27 knots. There is this difference, however: The destroyers now afloat are capable of maintaining their maximum speed for only three hours with half a load of coal aboard, while the new ones are expected to maintain 27 knots for four hours with a full supply of coal. To obtain these advantages weights must be rigorously economized, and prospective contractors have been asked whether the two sets of engines could not be built closely back to back, instead of separately, so that one central framing or support for the engines might suffice. The court of inquiry to investigate the wrecking of the Cobra, above mentioned, on September 18, whereby upwards of 70 lives were lost, has reported that the vessel simply collapsed because she was structurally weak, that she did not touch ground and that no errors were made in her navigation. The purchase of the Cobra for the government is condemned by the court.—*Army & Navy Journal*, October 26, 1901.

The source which inspired the foregoing is unknown, but it seems probable that the chief point which the Admiralty has in view is increased strength. The reduction of scantling, which has been made to attain very high speed, has proceeded to such lengths that probably few of the 30-knot boats are fit to go to sea except in moderate weather. As nearly all of them were tried at very light draught, compared with the ordinary condition of service, their legend speeds are deceptive. They cannot do anything like 30 knots after commissioning—not because less well handled, nor because the machinery was injured in the full speed trial, but because of greater displacement due to additional weights carried. But even if they could attain 30 knots their weakness makes them almost useless as a fleet adjunct. It is not merely that their shell plates are thin; their frames are too light, and their longitudinals of insufficient depth and stiffness to give the requisite girder strength at sea when the waves leave the middle or ends without much support from the water. As within a year, the Seal, Crane, and Vulture have sagged, or hogged, in not unusual weather, sufficiently to rupture their decks or side plating, while the Cobra broke in two and sank, it seems quite time to consider the question of strengthening future construction.

GREYHOUND: TRIALS.—The torpedo-boat destroyer Greyhound had her first trials on September 7. The details are: steam pressure, 240 pounds; I. H. P., 6373; revolutions, 393; mean speed for three hours, 30.15 knots; mean of several runs over the measured mile, 30.42 knots. On September 24, her second (official?) trials took place with the following results: steam pressure, 240 pounds; I. H. P., 6141; revolutions, 398; mean speed for three hours, 30.337 knots. The Greyhound is fully described in PROCEEDINGS No. 97, page 170.

ROEBUCK: TRIAL.—*Le Yacht* says that the official trials of this torpedo-boat destroyer, a sister in all respects to the Greyhound (see preceding paragraph), took place October 8, and that they were satisfactory; but that owing to the failure of a boiler tube the coal consumption trial was deferred until October 15. The *Rivista Marittima* says that the full power trial of the Roebuck took place on September 27 with the following results: steam pressure, 246 pounds; revolutions, 397; I. H. P., 6573; mean speed for three hours, 30.346 knots; mean of several runs over the measured mile, 30.436 knots.

SYREN: TRIAL.—"The torpedo-boat destroyer Syren, the last of a series of thirteen vessels supplied by Palmer's Shipbuilding Company, carried out her full-power trial at Portsmouth on Tuesday (September 10). The revolutions were 382.9 starboard and 380.2 port, and the total indicated horse-power was 6708. The air pressure was 3.6-in., and the mean speed of the three hours was exactly 30 knots. During the early part of the trial the vessel made six runs over the measured mile in Stokes Bay, when the mean indicated horse-power was 6689, and the speed 29.812 knots."—*Engineer* (London), September 13.

The Syren is described in PROCEEDINGS No. 97, page 170.

COBRA: FOUNDERING OF.—The British torpedo-boat destroyer Cobra foundered at sea September 18, and of the 79 persons on board only 12 were saved. The cause of the catastrophe has been ascribed, with a fair degree of certainty of its correctness, to her breaking in two amidships through the action of the sea, which left her middle body inadequately supported while her ends were lifted by the waves. The Cobra was much the largest of the British destroyers. Her displacement on service was considerably over 400 tons but, owing to changes after completion, her exact displacement, in any assigned condition as to weights carried, is unknown. She was undoubtedly weak. She was built on speculation by Sir W. G. Armstrong, Whitworth and Company, and was commenced in 1899. The Viper, built contemporaneously by Messrs. Hawthorn, Leslie and Company, was also built as a speculation. It was hoped that their high qualities would attract purchasers, and both vessels were acquired by the British Admiralty. When the Admiralty sent its inspector to report upon the Cobra, prior to completing the purchase, he decided that she was structurally weak, and so stated. Suggestions were made as regards the additions which would be considered by the Admiralty to be sufficient; but as the Cobra was a completed vessel, with engines and boilers in place, it was found to be impossible to do very much in the way of adding strength without pulling her to pieces. Nevertheless, after strengthening her as much as possible, the Admiralty accepted her.

A very full history of the Cobra, of her purchase and loss, and of other matters connected with her and with the Viper, is given in the *Engineer* (London) of October 25. It is so exceptionally clear, fair, and logical at all points that the compiler regrets its length forbids its inclusion in these notes.

TORPEDO BOAT NO. 107: TRIALS.—"Torpedo boat No. 107 passed her final official full-speed trial at the mouth of the Thames on Monday (September 23). The mean speed on the measured mile was 25.401, and that for the three hours 25.206, the indicated horse-power being 2899. The notable features of the trial were the smoothness with which the engines worked, the low air pressure in the stokeholds—1.6-in.—and the handiness of the boat in turning. The diameter of the circles at full speed was not more than three lengths under starboard helm, and four lengths under port helm; the boat remaining practically upright. The trial was made with the full sea-going load of 42 tons on board."—*Engineer* (London), September 27.

The first trials, early in September, were not satisfactory, the speed attained being only 24.5 knots. This torpedo boat, which is a sister to No. 108, is described in PROCEEDINGS No. 97, page 170.

TORPEDO BOAT NO. 108: UNSATISFACTORY TRIAL.—Torpedo boat No. 108 attempted her trials on October 18, but was unable to attain the required speed of 25 knots and, after an hour, the trial was discontinued.

NEW SUBMARINE BOATS: LAUNCHES, REMARKS.—"The first of the five British submarine boats launched at Barrow recently (this one was launched October 2) has been undergoing tests preparatory to further trials in deep water. She has been lifted out of the water by means of a floating dock, and deposited on a gridiron, where tests have been made, with a crew of six men on board, of the working of the system of compressed air. The men spent three hours inside the boat before they were restored to the open air. They found no difficulty in breathing, and, it is said, came out of the boat as fresh as possible."—*Engineer*, London, October 18.

A further series of tests of these boats will be undertaken, and for this purpose it has been decided to lengthen the Experimental tank at Horsea Island, Portsmouth. The tank is 1200 yards long, 60 yards wide, and 30 feet deep. The boats will just be able to enter as the entrance is 12 feet wide and the beam of the boats 11.75 feet. As regards crews for the boats, it appears there will be some difficulty. Only volunteers will be ordered to them and the Admiralty's call has not been freely responded to, notwithstanding the extra pay offered. Furthermore, the rigorous medical examination caused the rejection of most of the applicants. The boats are fully described in PROCEEDINGS No. 98, page 396.

HAZARD: TO BE USED AS TENDER TO THE SUBMARINES.—The gunboat Hazard (1070 tons, 3700 I. H. P., and 17 knots) is to be fitted out as tender to the submarines and flagboat of the flotilla.

## GREECE.

NEW PROGRAM, CONDITION OF NAVY, ETC.—The following note appears in the *Army & Navy Gazette* of November 2, 1901:

"According to the *Correspondence Politique*, Prince George of Greece

has been expressing very unfavorable opinions upon the Greek Navy, and the manner in which it is administered. It appears to be the prince's purpose to secure control of the naval forces, as he has already done of the military. A certain flutter has accordingly been created, and M. Delyannis has declared in an interview that his opinions were diametrically opposed to those of the prince, and that he would resist any idea of confiding to the latter the control of the navy, especially as the particular situation of the members of the Royal family deprives them of real responsibility. There seems to be some idea of expansion in the Greek Navy. A rumor has spread that a cruiser, a destroyer, and four torpedo boats would be built in England. A despatch from Rome to the *Echo de Paris* asserts that Messrs. Ansaldo, Orlando, Odero, and Pattison (of Naples) have formed themselves into a syndicate in order that they may undertake three armored cruisers of large size, and six torpedo boats for the Hellenic Government. The syndicate thus formed would last but eighteen months, and would only have reference to this particular commission, and the arrangement became necessary because the Greek Government demanded pecuniary advantages which no single firm could allow it. This, at least, is the story published by the *Echo de Paris*."

The remarks concerning the despatch from Rome to the *Echo de Paris* are confirmed by a similar note in the *Moniteur de la Flotte*. In regard to this matter *Le Yacht* says:

"The shipbuilding establishments of Ansaldo, of Sestri Ponente, Odero, of Genoa, Orlando, of Livorno (Leghorn), and Pattison, of Naples, have formed a syndicate to construct in eighteen months, with special privileges of payment, three armored cruisers and six torpedo boats. In addition, it is reported that four torpedo-boat destroyers will be built at Naples."

## ITALY.

PERSONNEL: NUMBERS.—"There are at the present time on the active list of the navy: 1 admiral, 7 vice-admirals, 14 rear-admirals, 58 captains, 70 frigate-captains, 75 corvette-captains, 410 lieutenants, 160 sublieutenants, and 110 midshipmen. The engineering staff consists of: 1 inspector-general of naval engineers, 2 inspectors, 7 directors, 9 chief engineers of first class, 11 chief engineers of second class, 17 engineers first class, 15 engineers second class, 8 assistant engineers first class, 12 assistant engineers second class, 1 inspector-general of officer-mechanics, 2 directors, 5 principal chief officer-mechanics first class, 20 principal chief officer-mechanics second class, 70 chief officer-mechanics, 103 chief officer-mechanics second class, 62 chief officer-mechanics third class. The medical department consists of: 1 inspector, 6 directors, 11 chief surgeons first class, 23 chief surgeons second class, 75 surgeons first class, and 63 surgeons second class. The commissariat branch consists of: 1 inspector, 6 directors, 17 chief paymasters first class, 26 chief paymasters second class, 107 paymasters first class, 107 paymasters second class, 28 assistant paymasters. There are 30 captains, 54 lieutenants, and 57 sublieutenants attached to the Corpo Reale Equipaggi, the men of which are enlisted voluntarily and from whose ranks are drawn the quartermasters, seamen-gunners, trained torpedo-men, mechanics, sick-berth attendants, etc.

"The strength of the seamen personnel is 22,496 men, made up of

3969 petty officers, 17,152 seamen, stokers, etc., 677 boys, and 700 specialists. The seamen number 7651, exclusive of 536 quartermasters and trained helmsmen; seamen-gunners and torpedo men, 5006; artificers, 1146; and stokers, 4149. The men are divided into classes, 18,352 being available for service afloat, and 4144 for shore duty."—*Journal of Royal United Service Institution.*

BENEDETTO BRIN: LAUNCH.—This first class battleship was launched at the government yard, Castellamare, November 7, 1901. She is a sister ship in all respects, except boilers, to the Regina Margherita, fully described in PROCEEDINGS No. 99, page 608. The boilers are of the Belleville type, 28 in number.

AMMIRAGLIO DI ST BON: TRIALS.—This first-class battleship had her trials in May and June. The results were as follows:

| Character of trial. | Forced draft. | Natural draft. |
|---|---|---|
| Date of trial | May 23. | June 26. |
| Mean draught on trial, feet | 24.9 | 25.0 |
| Corresponding displacement, metric tons | 9908. | 9950. |
| Days since last docking | 158. | 14. |
| Boilers in use | 12. | 12. |
| Duration of trial, hours | 1.5 | 6. |
| Stream pressure at boilers, pounds | 150. | 149.7 |
| Steam pressure at engines, pounds | 146. | 148. |
| Air-pressure in fire-rooms, inches of water | 1.26 | 0.33 |
| Revolutions, mean | 104. | 94.4 |
| Indicated horsepower | 14,296. | 10,407. |
| Speed, knots | 18.3 | 17.47 |
| Slip of screw, per cent. | 16.1 | 12.5 |
| Coal burned per I. H. P. per hour, pounds | 2.18 | 1.87 |

The operation of the machinery and boilers is reported to have been satisfactory.—*Rivista Marittima.*

## JAPAN.

NEW PROGRAM UNDER CONSIDERATION.—It is rumored that the Japanese government is considering the question of adopting a new building program. The *Jiji Shimpo*, one of the leading newspapers of Tokio, declares that a strong addition to the fleet is necessary. The sole question is that of expense, and if the funds can be obtained there is little doubt that the new program will be a fairly extensive one.

PERSONNEL: NUMBERS OF OFFICERS AND MEN.—There are at present in the Japanese navy 46 admirals, 1828 officers of less rank, 398 cadets, 2543 non-commissioned and petty officers, and 19,149 enlisted men (other than petty officers).

NIITAKA, TSUSHIMA: DESCRIPTION.—These second class protected cruisers are building at Japanese government yards, the former at Yokosuka and the latter at Kuré, though much of the material used in them came from abroad. They will be very similar to the Akitsushima, but the batteries of the new ships will be slightly heavier. The hull is of steel with ram bow and full stern without overhang. The double bottoms will extend throughout the boiler and engine room space and

slightly beyond. There will be two signal masts and three smokepipes. The bridge is forward of the foremast and has a searchlight on each end. A third searchlight will be carried on a raised platform aft. The principal details are:

*Armament.*—Six 6-inch guns: two in shields on poop and forecastle, and four in sponsons on the main deck, one each side abreast each mast. Ten 12-pounders: six in broadside between the 6-inch guns, one each side on the forecastle under the bridge, and one each side in the cabin, well aft. Four 3-pounders in broadside on the main deck, one each side between the forward 6-inch and forward 12-pounders, and one each side between the center and after 12-pounders. No torpedoes are to be carried.

*Protection.*—Complete protective deck, 1.5 inches thick on the flat and 3 inches on the slopes amidships. Thick gun shields over 6-inch guns, and possibly some armor or thick plating on the sponsons.

*Motive power.*—Twin-screw, triple-expansion engines, designed to develop 9400 I. H. P. and give a speed of 20 knots. Coal capacity, 600 tons. Niclausse boilers.

*Dimensions.*—Length, between perpendiculars, 334.6 feet; beam, 44 feet; mean draught, 16 feet; displacement, 3365 tons.

MIKASA: TRIAL.—The preliminary trials of the battleship Mikasa, 15,200 tons, gave a speed of 18 knots with 15,207 I. H. P. The Mikasa is fully described in PROCEEDINGS No. 96, page 706.

SHIRAKUMO: LAUNCH, DESCRIPTION.—The Shirakumo, torpedo-boat destroyer, built for the Japanese government by Messrs. T. J. Thorneycroft and Company, of Chiswick, was launched October 1. A sister boat, the Asashio, is building at the same works, but is not yet launched. The dimensions of these boats are: Length, between perpendiculars, 216.7 feet; beam, 20.75 feet; mean draught, 6 feet; displacement at this draught, 333 tons. The armament consists of one 12-pounder, five 6-pounders, and two torpedo tubes. The machinery is twin-screw, 4-cylinder, triple-expansion; I. H. P., 7000; estimated speed, 31 knots; bunker capacity, 90 tons. The boilers, four in number, are of the Thorneycroft-Schultz type. The designed speed of 31 knots is to be made at mean load draft of 6 feet, the weight carried being equal to 40 tons. The keel of the Shirakumo was laid on February 28, 1901.

AKATSUKI: LAUNCH.—The torpedo-boat destroyer Akatsuki was launched at the works of Messrs. Yarrow & Company, Poplar, November 13. The Kasumi, a sister boat building at the same works, is nearly ready for launching. The armament is the same as that of the Shirakumo (see preceding paragraph). The dimensions are: Length between perpendiculars, 220.25 feet; beam, 20.5 feet; mean draft, 5.33 feet; displacement at this draft, 325 tons. The estimated horsepower of the machinery is 6000, but this will probably be considerably exceeded. The designed speed is 31 knots; and the coal capacity is 90 tons.

ASAGIRI, HARUSAME, HAYATORI, MURASAME: PRINCIPAL DETAILS.—These torpedo-boat destroyers were ordered in December, 1900, and are under construction at the government yard, Yokosuka. The armament consists of one 12-pounder, five 6-pounders, and two torpedo tubes. The estimated I. H. P. of the machinery is 6000; designed speed, 29

knots; coal capacity, 100 tons. The dimensions are: Length between perpendiculars, 227 feet; beam, 21.5 feet; mean draft, 6 feet; displacement at this draft, 375 tons.

TORPEDO BOATS 57, 58, 59: REMARKS.—These boats, of about 80 tons, are under construction at Kuré dockyard and should be completed before the end of the year.

TORPEDO BOATS 60 AND 61: LAUNCHED.—These boats were built by Herr F. Schichau, of Elbing, and sent out to Japan in sections. They were put together at the Kawasaki Works, Kobe, and launched last June. Their displacement is 83 tons.

TORPEDO BOATS 62, 63, 64, 65, 66: REMARKS.—These boats were built by Messrs. Yarrow and Company and sent out to Japan in sections like Nos. 60 and 61. They are being put together at Sasebo and are probably now about ready for trials.

NEW BOATS OF 88 TONS.—Five boats of 88 tons are to be built in Japan; three at Sasebo and two at Yokosuka. The material has been ordered and work on them is expected to begin about the end of the present year (1901). Their dimensions are to be as follows: Length between perpendiculars, 131.5 feet; beam, 16.25 feet; mean draft, 3.3 feet; displacement, 88 tons. The estimated I. H. P. of the machinery is 1200; speed, 23.5 knots; coal capacity, 14 tons. Armament, two 3-pounders and three torpedo tubes.

AWATAKI, HATO, HIBARI, KARI, KIJI, AND TSUBAME: ORDERED.—In November, 1900, orders were sent to the Kuré dockyard to build six torpedo boats of 150 tons each, to which these names are to be given. A portion of the material for the boats has been received, and it is probable that they are now all under way. The work on the boilers and engines is nearly completed. The dimensions are to be: Length between perpendiculars, 147.6 feet; beam, 16 feet; mean draught, 4.75 feet; displacement, 150 tons. The estimated I. H. P. of the machinery is 4200; corresponding speed, 29 knots; coal capacity, 25 tons. Armament, three 3-pounders and three torpedo tubes.

## MEXICO.

NEW GUNBOATS: DESCRIPTION.—These two vessels are building at the yard of the Crescent Shipbuilding Company, Elizabeth, N. J. This company was not the lowest bidder, but its plans were preferred by the Mexican government. The vessels are of steel without sheathing, and have quarters suited to a tropical climate; and, in addition to the regular crew, 200 soldiers can be berthed on board. This permits of their use for transporting small bodies of troops from one port to another without the loss of time which might be required if it were necessary to wait for a regular transport. The head of the Mexican commission which is superintending the building of the boats is Colonel Flaviano Paliza, who has with him a construction engineer and a large force of officers and cadets who will see every part as it is built into the vessels and will be ordered to duty on them when they are completed. The principal details are:

*Armament.*—Four 4-inch; four 6-pounders; one bow torpedo tube.

*Motive power.*—The engines are twin-screw, triple-expansion, designed to develop about 2400 I. H. P. and give a speed of 16 knots. The coal supply will be sufficient for 7000 miles at 10 knots.

*Dimensions.*—Length, 200 feet, beam, 33 feet; draft, 10 feet; displacement at this draft, 1000 tons.

## NETHERLANDS.

NEW TORPEDO BOATS FOR EAST INDIES.—Four torpedo boats for service in the Netherlands East Indian marine have been ordered from the Schelde Shipbuilding Company, of Vlissingen. The contract price is 297,000 florins ($119,394), and the contract time for delivery is 13 months.

## NICARAGUA.

ARMINIUS: PURCHASED FROM GERMANY.—A despatch from Managua to the *New York Herald* says that the Nicaraguan government has purchased from Germany the old armored gunboat Arminius. This old craft is built of iron and was launched in 1864. She was struck from the list of the German navy some years ago and has since been used for harbor service. The principal details are:

*Armament.*—Four 21-centimeter (8.27-inch), 10-ton, breech-loading rifles of old type. These may be supplemented by light rapid-firing guns.

*Protection.*—Armor belt, 4.5 inches thick, iron. Turret armor, 7.25 inches.

*Motive power.*—Single-screw engines of 1200 I. H. P. Speed when new, 10.5 knots. Coal capacity, about 200 tons.

*Dimensions.*—Length, 197.3 feet; beam, 36 feet; draft, 13.8 feet; displacement, 1583 tons.

## NORWAY.

NAVAL BUDGET FOR 1901-02.—According to *Le Yacht*, the naval budget for 1901-02 amounts to 4,550,000 crowns ($1,219,400; 1 crown = $0.268) in the ordinary expenditure, which is an increase of 65,000 crowns over the budget for 1900-01. The sum of 1,388,000 crowns is for pay; 390,000 for schools; 1,067,000 for armaments; and 1,164,000 for new construction. In addition to this, the extraordinary expenditure is fixed at 2,850,000 crowns.

## PORTUGAL.

TEJO: LAUNCH, DESCRIPTION.—This high speed gunboat was launched at the royal naval arsenal, Lisbon, on October 27. The Tejo was built upon plans by M. Croneau, chief constructor. The hull is of nickel steel, and the following are the principal details:

*Armament.*—One 65-millimeter (2.56-inch) gun on the forecastle; six 3-pounders; three on each beam; one 0.4-inch machine gun on the poop; two torpedo tubes.

*Motive power.*—Twin-screw, triple-expansion engines of 7000 I. H. P., designed to give a speed of 25 knots. The boilers are of the Sigaudy water-tube type.

*Dimensions.*—Length over all, 231.6 feet; between perpendiculars, 229.6 feet; beam, extreme, 23.9 feet; beam at the water-line, 22.96 feet; depth, 13.1 feet; draft, 7.2 feet; displacement, 532.7 tons (metric).

## RUSSIA.

BUDGET FOR 1901-02.—The Russian budget has not yet appeared in full in any publications which have reached the compiler. It will be given at length in the next number of the PROCEEDINGS. According to the Kronstadtskii Viestnik, the total amount of the budget is 98,318,984 roubles ($50,634,276.76; 1 rouble = $0.515). Of this, the sum of 36,903,856 roubles is for naval construction and armament; 20,485,000 for expenses of ships in commission; 5,359,994 for construction works; 10,891,845 for pay of employès on shore; 4,026,738 for the construction of the port of Emperor Alexander III; 5,200,000 for the improvement of Port Arthur and the port of Vladivostok; 5,740,523 for navy yards and building establishments; 2,402,674 for the superintendence and direction of ports; 1,128,638 for maintaining establishments of instruction and 1,214,063 for hospitals and medical service.

NEW VESSELS ORDERED.—According to the Novosti, five new armored ships with a speed of 20 knots and a displacement in excess of 12,000 tons, are to be built in Russia. The *Mittheilungen aus dem Gebiete des Seewesens* says that four first class armored cruisers are to be built, one each at Libau, Nicolaiev, Windau, and Sevastopol.

KAGUL, OTSHAKOV: CHRISTENING CEREMONY.—The official ceremony of attaching the silver plate to the keels took place recently—that of the Otshakov at Sevastopol on August 28, and of the Kagul at Nicolaiev, September 9.

BORODINO: LAUNCH.—The first class battleship Borodino, 13,576 tons, was launched at the New Admiralty yard, St. Petersburg, September 8, 1901. A very full description of the Borodino is given in PROCEEDINGS No. 97, page 178.

POBIEDA: TRIAL.—On October 14, the battleship Pobieda, 12,674 tons, underwent steam trials, attaining a speed of 18.5 knots. The ship is not completed in her battery and upper works and may not be ready for service until late next spring.

NOVIK: TRIAL.—According to *Le Yacht*, the Novik has had preliminary trials on which the designed speed of 25 knots was exceeded.

RETWISAN: TRIALS.—On her first trial the Retwisan maintained a speed of 18.8 knots for 12 hours. During one hour the speed was over 19 knots. The Retwisan is fully described in PROCEEDINGS No. 97, page 181.

LIEUTENANT BOUROKOFF: NAMED.—The torpedo-boat destroyer of 280 tons, 6500 I. H. P., and 32 knots, taken last year from the Chinese at Taku, has been named Lieutenant Bourokoff and added to the Siberian Fleet.

AKOULA, BYTCHEK: LAUNCH; NAMES OF OTHERS OF CLASS.—The torpedo boats Akoula and Bytchek were launched at the Neva Works, St. Petersburg, on August 24. They are of 150 tons displacement, 4200 I. H. P., and 26 knots speed. There are ten similar boats building at

the Neva Works; the names of the others are: Keta, Maknel, Nalim, Okun, Paltus, Pescar, Plotva, and Sig.

BAKLAN: LAUNCH.—The torpedo-boat destroyer Baklan, 350 tons, was launched at the Neva Works, St. Petersburg, August 12, 1901. The names of the boats of this class are given in PROCEEDINGS No. 97, page 183.

GAGARA, VORON, FILIN, SOVA: TRIALS, DESCRIPTION.—These boats are of the Sokol type and were built at the New Admiralty Works, St. Petersburg. They have all completed their trials recently. The speeds were: Gagara, 27 knots; Voron, 28 knots; Filin, 26.94 knots; Sova, 26.81 knots. The principal details of these boats are said to be:

*Armament.*—One 12-pounder; three 3-pounders; two torpedo tubes.

*Motive power.*—Twin-screw, triple-expansion engines of 3800 I. H. P., designed to give a speed of 26.5 knots. The boilers are of the Yarrow type and are eight in number.

*Dimensions.*—Length, 190 feet; beam, 18.5 feet; maximum draft, 11.5 feet; displacement, 240 tons.

BERKUT, YASTREB, NYROK: TRIALS.—These torpedo-boat destroyers are similar to the Gagara class, described in the preceding paragraph, except that they are reported to be 10 feet longer, to have 6 inches more beam, and 6 inches less draft. They were built at the Ijora Works and the first two have had satisfactory trials. The Nyrok failed on her first trial (October 10), being only able to maintain a speed of 26.18 knots instead of 26.5 knots.

MININ: REFIT.—The old armored cruiser Minin (6168 tons, 5290 I. H. P., and 13 knots), is going to be reconstructed for the third time.

PAMYAT AZOVA: REFIT.—The armored cruiser Pamyat Azova (6096 tons, 11,500 I. H. P., 17.5 knots) will receive next year new boilers of the Belleville type, which are now under construction at the Franco-Russian Works, St. Petersburg. At the same time she will have extensive repairs and alterations, such as the reduction of the height of the smokepipes and reduction of the masts from three to two.—*Le Yacht*, October 5.

ALEXANDER II: REFIT COMPLETED.—The repairs and refit of the old battleship Alexander II have been completed at La Seyne.

## SPAIN.

NEW PROGRAM.—It is stated that the ministry of marine has presented to the Cortes a project for the construction of eight battleships of 12,000 tons and four cruisers of 8000 tons, and asked for a credit of 12,000,000 pesetas ($2,316,000) for commencing work upon them. The cruisers are to be built in Spain but the battleships will be ordered abroad. In a despatch from Madrid to the *New York Herald*, dated November 15, it is stated that the Duke of Veragua, minister of marine, has threatened to resign if the credits for the new construction are not granted. By referring to PROCEEDINGS No. 97, page 184, it will be seen that the present program is a revival of that presented by the previous ministry shortly before it went out of office.

## SWEDEN.

BUDGET FOR 1902.—The budget for 1902 amounts to 21,445,025 crowns ($5,747,266.70; 1 crown = $0.268), of which 10,461,982 is for ordinary expenses. The sum of 6,996,110 crowns is allotted for expenses of the fleet, of which 3,851,740 crowns are for personnel, 1,685,000 for material, and 1,479,496 for armaments. In the extraordinary budget the sum of 6,693,915 is allotted for continuing the construction of armored ships A, B, and C; for two torpedo boats of the first class, two of the second class, and for commencing work upon another armored vessel. The sum of 1,206,000 crowns is allotted for the armament of these vessels, and 280,000 crowns for continuing the reconstruction of the monitors Thordön and Tirfing.

PERSONNEL: NUMBERS.—The vote in the Swedish parliament provided for an increase of the personnel of the navy, consisting of 50 officers, 53 petty officers, 350 men and 80 boys. This will give a total of 210 officers, 362 petty officers, 2825 men and 400 boys.

TORPEDO-BOAT DESTROYER: ORDERED.—A torpedo-boat destroyer of 31 knots, of the most modern type, fitted to use both coal and liquid fuel, has been ordered of Yarrow, Poplar.

## TURKEY.

THE TURKISH PROGRAM.—During the recent war with Greece the Turkish government awakened to the fact that operations were seriously hampered by the condition of the fleet, and that only the inactivity of the Greek squadron, combined with general European diplomatic considerations affecting Crete, prevented the bombardment of, or levy upon, the Turkish Mediterranean ports. Soon after the war the question of improvement of the fleet was discussed, and it was finally concluded that the financial condition of the country and the time required to produce new ships made it desirable to rebuild the old vessels rather than order new ones. The work was taken in hand at once, and at present nearly all the old heavy ships of the Turkish navy are undergoing reconstruction, while new machinery has been installed in the Turkish arsenals; and it was expected that work upon the Abdul Kader, whose frame was rusting on the stocks, would be rapidly pushed. Having no cruisers to repair, it was decided to build some, and orders were placed with Cramp, Armstrong, and Krupp for one cruiser each. A description of the Armstrong cruiser is given in PROCEEDINGS No. 99, page 614. The cruiser building at Philadelphia is of the same design and dimensions; and that to be built by Krupp is very similar.

MESUDIEH: RECONSTRUCTION.—This old battleship of 9140 tons has just been rebuilt at the works of Messrs. G. Ansaldo and Company, Sampierdarena, near Genoa. The boilers and machinery were removed, and the stern was braced and strengthened. Then twin-screw, triple-expansion engines of 11,000 I. H. P. were put in place of the old ones, which operated a single screw. The new boilers, 16 in number, are of the Niclausse type and are installed in four groups of four boilers each. This disposition requires two smokepipes, and they are much higher than the old ones. The expected speed with the new machinery is 15 knots.

The deck, which covered in the old battery and rested on top of the armor, was strengthened. Above it everything (including bulwarks and rail) was cut away, leaving this the main deck (U. S. Naval system of nomenclature). Above the main deck amidships was erected a superstructure which conforms in shape to the armored enclosure below it, except at the extreme ends, which do not curve out. This superstructure is covered in and the upper deck so formed surrounded by a light rail. Above it, at each end, are the usual bridges. The armor on the side of the ship is undisturbed, except that the ports for the battery are slightly enlarged, but the guns are fitted with thick shields which completely close the opening. The old masts have been removed and replaced by a single military mast abaft the smokepipes, carrying a military top and a small search-light platform. The battery consists of: two 9.2-inch guns (see "Guns," page 812), one forward, one aft, in oval balanced turrets of face-hardened armor, 6 inches thick in front and 3 inches on sides and rear; twelve 45-caliber 6-inch Vickers' guns in the central armored battery, six each side, with semi-circular shields 4.5 inches thick, which completely close the ports; fourteen 3-inch, five each side in the central superstructure and one each side forward and one each side aft on the gun-deck; ten 6-pounders, three each side on the superstructure, and one each side on the forward and after bridge decks; two 3-pounders in the military top; two boat guns.

The dimensions of the Mesudieh are: Length, 331.4 feet; beam, 59 feet; mean draft, 26 feet; displacement at this draft, 9120 tons.

ORKANIEH, OSMANIEH, AZIZIEH, MAHMUDIEH, MUKADEM-I-HAÏR, FETH-I-BULEND, AVNI-ILLAH, MUIN-I-ZAFFER: RECONSTRUCTION.—These vessels are all to be repaired at the works of Messrs. G. Ansaldo and Company, Sampierdarena. The four last-named are to be rebuilt, receiving new boilers and engines and a new battery; the others are to have a general refit and be rearmed. The main armament of the larger vessels will consist of one 8-inch gun forward, one 6-inch gun aft, eight 6-inch in the citadel, and eight 3-inch.

## UNITED STATES.

PROGRAM FOR 1902-03.—In his annual report the Secretary of the Navy recommends the authorization of the following vessels:

Three first class battleships; two first-class armored cruisers; three gunboats, each of about 1000 tons trial displacement; three gunboats, each of about 200 tons trial displacement, for insular service; three picket boats, each of about 650 tons trial displacement; three steel sailing training ships, each of about 2000 tons displacement; one collier of about 15,000 tons trial displacement; four tugboats.

PERSONNEL: RECOMMENDATIONS OF THE SECRETARY OF THE NAVY.—In his annual report, Secretary Long makes the following recommendations in regard to the personnel:

That the grade of vice-admiral be revived and that the number in the grade be fixed at two (in a later recommendation this is increased to four); that the personnel of the navy be largely increased; that the list of lieutenants be immediately increased to 350, and that of the junior lieutenants and ensigns be increased to 600; an increase in the list of the construction corps; some increase of the list of civil engineers; that no

more professors of mathematics be appointed; that the enlisted force be increased by 3000; that the marines be increased 750; that the title of naval cadet be changed to that of midshipman; that the probationary course of cadets be reduced; that no cadet shall be less than 15 years old nor more than 18 on October first of the year of entrance to the Naval Academy; that officers be not retired in the next higher grade (sections 8 and 9 of the Personnel Act); that all officers advanced numbers be made additional, and not simply those advanced for service in the war with Spain; that the service of retired officers should be counted to advance their rank and pay; and that all service for enlisted men in the army, navy and marine corps should be counted towards the 30 years required for retiring.

NAVAL ESTIMATES FOR 1902-03.—"The naval estimates for the fiscal year 1902-03 amount to $98,910,984.63, which is $20,986,449.03 more than for 1901-02. The increase in the estimates for 1903 over the amount appropriated for 1902 for the same purposes was as follows: Pay of the Navy, $1,297,915; emergency fund, $50,000; Bureau of Navigation, $289,646.25; Bureau of Ordnance, $1,303,100; Bureau of Equipment, $1,003,200; Bureau of Yards and Docks, $129,325; public works, Bureau of Navigation, $365,530; public works, Bureau of Ordnance, $1,265,700; public works, Bureau of Equipment, $747,800; Bureau of Medicine and Surgery, $55,000; Bureau of Supplies and Accounts, $826,652; Bureau of Construction and Repair, $2,600,000; Bureau of Steam Engineering, $846,100; Naval Academy, $36,590.32; Marine Corps, $384,600.46; increase of Navy, $2,000,000; total, $31, 148,534.03. The amount recommended for increase of the Navy is $23,703,010, or $1,696,990 less than last year. There is an increase of $2,000,000 in armament and a decrease of $3,696,990 for machinery. The largest single increase is in the estimate for work in the Bureau of Yards and Docks. Last year the appropriation for this purpose was $6,775,010, while the estimate for the new year is $20,781,375. The estimate for the Naval Academy improvements is $1,500,000, half the amount of last year's appropriation."—*Army and Navy Journal*, October 19.

It is needless to give the estimates in detail as the appropriation bill usually makes very great changes. The provisions of the bill as it passes Congress will be published in No. 102 of the PROCEEDINGS if the bill has been disposed of in time.

CONDITION OF SHIPS BUILDING.—The following is the condition of vessels building on November 1 in percentages of the total work required to complete them:

BATTLESHIPS.

| No. | Name. | Per cent. | No. | Name. | Per cent. |
|---|---|---|---|---|---|
| 10. | Maine | 70 | 14. | Nebraska | 0 |
| 11. | Missouri | 48 | 15. | Georgia | 2 |
| 12. | Ohio | 43 | 16. | New Jersey | 2 |
| 13. | Virginia | 0 | 17. | Rhode Island | 2 |

ARMORED CRUISERS.

| | | | | | |
|---|---|---|---|---|---|
| 4. | Pennsylvania | 6 | 7. | Colorado | 9 |
| 5. | West Virginia | 2 | 8. | Maryland | 2 |
| 6. | California | 0 | 9. | South Dakota | 0 |

PROTECTED CRUISERS.

| No. | Name. | Per cent. | No. | Name. | Per cent. |
|---|---|---|---|---|---|
| 14. | Denver | 58 | 19. | Cleveland | 68 |
| 15. | Des Moines | 57 | 20. | St. Louis | 0 |
| 16. | Chattanooga | 48 | 21. | Milwaukee | 0 |
| 17. | Galveston | 45 | 22. | Charleston | 0 |
| 18. | Tacoma | 20 | | | |

MONITORS.

| | | | | | |
|---|---|---|---|---|---|
| 7. | Arkansas | 75 | 9. | Florida | 74 |
| 8. | Nevada | 91 | 10. | Wyoming | 75 |

TORPEDO-BOAT DESTROYERS.

| | | | | | |
|---|---|---|---|---|---|
| 1. | Bainbridge | 99 | 9. | Macdonough | 98 |
| 2. | Barry | 92 | 10. | Paul Jones | 85 |
| 3. | Chauncey | 96 | 11. | Perry | 89 |
| 4. | Dale | 97 | 12. | Preble | 87 |
| 5. | Decatur | 98 | 13. | Stewart | 63 |
| 6. | Hopkins | 76 | 14. | Truxton | 78 |
| 7. | Hull | 75 | 15. | Whipple | 77 |
| 8. | Lawrence | 99 | 16. | Worden | 76 |

TORPEDO BOATS.

| | | | | | |
|---|---|---|---|---|---|
| 19. | Stringham | 98 | 30. | O'Brien | 98 |
| 20. | Goldsborough | 97 | 33. | Thornton | 97 |
| 27. | Blakely | 98 | 34. | Tingey | 70 |
| 28. | De Long | 98 | 35. | Wilkes | 90 |
| 29. | Nicholson | 97 | | | |

SUBMARINE BOATS.

| | | | | | |
|---|---|---|---|---|---|
| 1. | Plunger | 45 | 6. | Pike | 50 |
| 3. | Adder | 92 | 7. | Porpoise | 80 |
| 4. | Grampus | 51 | 8. | Shark | 74 |
| 5. | Moccasin | 85 | | | |

A table giving the places where the vessels are building is to be found in PROCEEDINGS No. 98, page 401.

NEW BATTLESHIPS: GENERAL FEATURES.—The *Army and Navy Register*, of November 30, says that the Construction Board has agreed upon the designs of the new battleships, which are to be of about 16,000 tons displacement. The battery will consist of four 12-inch guns in pairs in turrets forward and aft; eight 8-inch guns in pairs in four turrets on the main deck, placed like those of the Indiana and Iowa; twelve 7-inch guns in broadside on the gun deck; twenty 3-inch; and the usual number of machine guns and auxiliary pieces. No torpedo tubes are to be fitted.

NEW ARMORED CRUISERS: GENERAL FEATURES.—These vessels, as recommended by the Board of Construction, will have a displacement of about 14,500 tons; speed, 22 knots; I. H. P., about 25,000; coal supply, about 2000 tons. The entire superstructure will, it is said, be armored. The armor over the broadside battery will be 5 inches; conning tower, 9 inches. The battery will consist of four 10-inch guns in pairs in turrets forward and aft; sixteen 7-inch guns; twenty 3-inch; and the usual smaller pieces. No torpedo tubes will be fitted.

OLONGAPO NAVY YARD: LAND ACQUIRED AND RESERVED.—"The President has signed an executive order creating a naval reservation of a large tract of land just acquired by the Navy Department at Olongapo, on Subig Bay, Luzon. The department will now proceed with all dispatch to construct at this point a navy yard and station of the first order, patterning the plans generally after the Mare Island Navy Yard. As soon as this station is properly equipped a large part of the work now done at the Cavite Navy Yard will be transferred to Olongapo. The latter yard can also undertake repairs of the larger vessels of the Asiatic fleet, which are now expensively repaired at Hong Kong. It is a part of the project to ship the Havana floating dock to Olongapo to supply immediate docking needs, and to remain until permanent stone docks can be constructed."—*Army and Navy Register*, November 16.

SAN JUAN NAVAL STATION: ESTIMATES FOR, ETC.—"Secretary Long will probably submit estimates to Congress in December, amounting to about $3,000,000, for the establishment and equipment of a naval station on the Puntilla at San Juan. The property which will be purchased will cost $500,000. Of course a dry dock will be built in addition to the shops, railroad facilities, etc."—*Army and Navy Register*, September 7.

NEW DRYDOCKS: ALGIERS, GUAM, NEW YORK.—The floating dock for the Algiers naval station has been towed there from Baltimore, where it was launched on October 3. It is 525 feet long over the blocks, has an entrance 100 feet wide between the walls, and will have a maximum lifting power of 18,000 tons. It will be attached to two steel columns on shore by two steel lattice booms, articulated in all directions; and it will therefore be free to rise and fall with the Mississippi River, which has frequent changes of level, as well as to rise and sink while being operated.

The building of a drydock at Guam is under consideration. Owing to the character of the rock in the harbor, the excavation of a large dock would probably be easy and cheap.

Stone dock No. 4 at the New York Yard will probably be commenced early in 1902. The buildings which are on the site of the dock are all old and none are of much value. They are No. 17, used as a saw mill; No. 19, boat shop; No. 44, master shipwright; No. 25, construction and repair rigging loft; No. 26, ordnance storehouse and crematory.

CINCINNATI AND RALEIGH AS TRAINING SHIPS FOR FIREMEN.—The *New York Herald* says that Secretary Long has decided to fit out the Cincinnati and Raleigh as training ships for firemen in the navy. These vessels were selected as they have good power, water-tube boilers, and will be able to accommodate a large engineer's force.

NATIVE FIREMEN IN THE PHILIPPINES.—"The bureau of navigation of the Navy Department has completed arrangements for the maintenance of the insular force in the Navy. The men are rated as native seamen, native firemen, etc., with monthly pay ranging from $8 to $28. Men for the insular force will be assigned only to vessels in service in the Philippines and at Guam. They will not be detailed for duty on board of vessels other than those on the station where the men enlisted, and upon such vessel leaving the station, men belonging to the insular force will be transferred to a vessel remaining on the station, unless they make

request in writing to remain on board the vessel to which attached and to be discharged wherever the vessel may be at expiration of enlistment." —*Army and Navy Register*, September 7.

CLEVELAND: LAUNCH.—The second class protected cruiser Cleveland, 3100 tons, was launched at the Bath Iron Works, September 28, 1901. The vessels of this class are fully described in PROCEEDINGS No. 94, page 376.

ILLINOIS: TRIAL.—The full data of the trial of the Illinois were not available when the notes for No. 99 were prepared. The following particulars are derived from the very full report of the trial by Lieutenant J. M. Pickrell, which appears in the August number of *Journal of the American Society of Naval Engineers:*

| | Starboard. | | Port. |
|---|---|---|---|
| Steam at boilers, pounds | | 177. | |
| Steam at high-pressure cylinder, pounds | 175.8 | | 174.1 |
| Vacuum in condensers, inches of mercury | 24.6 | | 24.3 |
| Revolutions per minute, main engines | 118.4 | | 117.3 |
| Mean speed per hour, knots | | 17.449 | |
| Slip of propeller in per cent of its own speed, based on mean pitch | 13.54 | | 12.7 |
| Air-pressure in fire rooms, inches of water | | 0.7 | |
| I. H. P., main engines only | 6,219.42 | | 6,427.21 |
| I. H. P., main engines, air, circulating and feed pumps | | 12,757 | |
| I. H. P., main engines and all auxiliaries in operation during trial | | 12,898.7 | |

The battleships of this class (Alabama, Wisconsin, Illinois) are fully described in PROCEEDINGS No. 96, pages 709 and 720.

NICHOLSON: LAUNCH, DESCRIPTION.—This torpedo boat, which is one of the last to take the water of those authorized in 1898, was launched at the Crescent Shipyard, Elizabethport, September 23, 1901. A sister boat, the O'Brien, was launched September 24, 1900. The contract for the Nicholson was executed September 26, 1898, and the keel laid December 6 following. The contract price for hull and machinery is $165,000. The complement will be 3 officers and 26 men. The principal details are:

*Armament.*—Three tubes for 18-inch Whitehead torpedoes and three 3-pounders.

*Motive power.*—Twin-screw, vertical, triple-expansion engines, designed to develop about 3000 I. H. P. and give a speed of 26 knots. Three Mosher boilers.

*Dimensions.*—Length on water-line, 174.5 feet; extreme breadth, 17 feet; mean draft, 4.5 feet; displacement at this draft, 174 tons.

BAINBRIDGE, CHAUNCEY: LAUNCH, DESCRIPTION.—These two torpedo-boat destroyers are building at the works of the Neafie and Levy Ship and Engine Building Company, Philadelphia. The Bainbridge was launched on August 27 and the Chauncey on October 26. The contract for their construction was signed October 1, 1898, and the keels were laid August 15, 1899, and December 2, 1899, respectively. The complement is 4 officers and 69 men. The principal details are:

*Armament.*—Two 3-inch guns; five 6-pounders; two tubes for long 18-inch Whitehead torpedoes.

*Motive power.*—Twin-screw, vertical, triple-expansion engines, designed to develop 8000 I. H. P. and give a speed of 29 knots. Four Thorneycroft water-tube boilers, having 315 square feet of grate area and 17,768 square feet of heating surface. Normal coal supply, 25 tons; bunker capacity, 139 tons.

*Dimensions.*—Length on load water-line, 245 feet; extreme breadth, 23.6 feet; mean draft, 6.5 feet; displacement at this draft, 420 tons; maximum draft aft, vessel ready for sea, bunkers full, 7.56 feet; corresponding displacement, 535 tons; tons per inch of immersion at normal draft, 9.4.

WILKES: LAUNCH, DESCRIPTION.—This torpedo boat is building at the works of the Gas Engine and Power Company and Charles L. Seabury Company, Consolidated, at Morris Heights, New York, where she was launched September 28. The contract was executed September 30, 1898; contract price, $146,000. The keel was laid June 3, 1899. The complement is 3 officers and 26 men. The principal details are:

*Armament.*—Three 3-pounders, three 18-inch tubes for Whitehead torpedoes.

*Motive power.*—Twin-screw, vertical, triple-expansion engines, designed to develop 3000 I. H. P. and give a speed of 26.5 knots. Seabury boilers. Normal coal supply, 10 tons; bunker capacity, 70 tons.

*Dimensions.*—Length on load water-line, 175 feet; extreme breadth, 17.64 feet; mean draft, 4.67 feet; displacement at this draft, 165 tons; maximum draft aft with full load, 7.5 feet; tons per inch at normal draft, 5.25.

TORPEDO BOAT DOCKS AT NORFOLK.—"The Navy Department has completed the plans for housing torpedo boats at the Norfolk Navy Yard. The establishment to be provided will be known as torpedo rendezvous No. 2 and the first work to be undertaken is the construction of mooring slips which will be located on St. Helena, situated on the Elizabeth River directly opposite the main part of the Norfolk Yard. The work includes the excavation of slips to a depth of 20 feet at mean low water; the construction of a timber wharf, as shown on plans; the construction of six piers, making seven slips for torpedo vessels, five being about 72 by 292 feet in the clear between rolling fenders, each wide enough for two destroyers or three torpedo boats; one about 80 by 292 feet in the clear and one about 88 by 340 feet; the furnishing of bollards, standard gauge track, eight small gangways, cleats, steam pipe and connections, water pipe and connections, electrical conduit and fittings, metal poles, lamps and wiring for lighting, fixed wooden benches, rolling fenders, in order to make complete slips for housing torpedo vessels. The Navy Department proposes to expend $70,000 on this work."—*Army and Navy Register*, November 9.

PORPOISE, SHARK: LAUNCH.—These two submarine boats, which are building at the Crescent Shipyard, Elizabethport, N. J., have been launched, the former on September 23 and the latter on October 18. The boats of this type are fully described in PROCEEDINGS No. 99, page 622.

## VENEZUELA.

NEW PROGRAM.—*Le Yacht* states that the Venezuelan government is purchasing in Germany a cruiser and two torpedo boats.

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## AMMUNITION.

CANISTER FOR U. S. ARMY.—The Chief of Ordnance, U. S. Army, says: "The results of the test with the combination fuze for 3.2-inch field gun showed that with the fuze cut at zero the minimum effective range of shrapnel is about 200 yards, and the necessity of sometimes covering the ground within this range, particularly in street fighting, coupled with the good dispersion of fragments afforded by canister at close ranges, leads to the conclusion that the shrapnel with the fuze now used cannot be advantageously employed as a substitute for canister." Canister is of great value to vessels operating against infantry, particularly to gunboats in small harbors and narrow rivers. The lack of it in our operations in the Philippines was frequently deplored.

LYDDITE SHELL IN SOUTH AFRICA.—The more we learn of the behavior of lyddite in shells for field guns the less does its value appear. In PROCEEDINGS No. 98 (page 407) there is a note in regard to lyddite shell. Captain Slocum, U. S. Army, in his report to the War Department upon the operations in South Africa, says: "The Lyddite shell has proven one of the distinct disappointments of the war. It has no effect whatever against intrenchments. On exploding, which it almost always does, as far as I could judge, it only makes a small hole about a foot deep and two feet in circumference, and breaks into few fragments. Against the armor of a battleship, for which they are designed mainly, I have no doubt that they would be very effective, and the poisonous gases confined in a closed space would be destructive, but in the open air they are too quickly dissipated to do any injury." As naval officers well know, lyddite shell are *not* effective, as they cannot be driven through armor before exploding.

LYDDITE SHELL: THE OKEHAMPTON ACCIDENT.—While two sergeants and a private were digging out an unexploded lyddite shell on the range at Okehampton, England, it burst, blowing one of the men to pieces and doing nearly as much to his companions. The ultimate cause of the explosion is unknown. Perhaps the shell was struck with a pick or shovel in such a way as to give a sufficient shock to the fuze. We also know that picric acid will and does attack the iron of the shell, forming ferrous picrate, which is remarkably ready to take fire if struck. Furthermore, if the mealed powder in the fuze should be forced into the shell chamber and into contact with the picric acid a very slight amount of moisture might cause the formation of ammonium or potassium picrates, the latter very sensitive. Whatever was the cause, it is plain that unexploded lyddite shell are exceptionally dangerous to handle; and unexploded shells filled with black powder are not the innocuous objects so many consider them.

ARMOR-PIERCING SHELL IN BRITISH NAVY.—A question was asked in the House of Commons on Thursday, the 25th inst., respecting the use

of armor-piercing shell in the Navy. The Secretary to the Admiralty, in reply, said this kind of shell is not filled with high explosives. Shell containing lyddite detonate against thin armor and do little damage inside the ship. No official information had been received showing that the United States Government had adopted a high explosive which can be carried through thick armor, and which does not detonate outside the plate, but explodes by the action of the fuse only. The question whether it was possible or desirable to substitute a high explosive for black powder in armor-piercing shell is now under consideration of the Explosives Committee.—*Engineer* (London), August 2.

LUMINOUS AND SMOKE SHELLS.—Experiments are reported to have been made in Russia with shells containing acetylene gas in addition to a bursting charge. The explosion of the projectile causes the acetylene to take fire, thus producing an illumination of 500 to 800 candle power. A German, Herr R. Fielder, has patented a method of rendering the bursting of shells visible at long distances by including in the smokeless powder charge of the shell a cartridge of amorphous phosphorus which, on combustion, produces a dense, snowy white smoke. The major portion of the charge may be made up of this substance, so that, it is claimed, a dense wall of smoke will be produced in front of the enemy, depriving him of a view of the field.

## ARMOR.

UNITED STATES: ROYALTIES FOR ARMOR.—The Acting Attorney-General, Mr. James M. Beck, on August 23, rendered an important decision in regard to the right of the Navy Department to withhold payment upon vouchers in favor of the Carnegie Steel Company and the Bethlehem Steel Company, as royalty for the use of the Harvey process in the manufacture of nickel-steel armor plate. The two claims arose under similar contracts, and are, therefore, settled together. The Attorney-General adhered to his former decision in this matter, and decided that payment could not be made at the present time in view of the pending litigation between the Government and the Harvey Steel Company, with respect to the validity of the letters patent. The comptroller says: "If the contention of the Government be sound and the process used by the Carnegie Company in hardening these plates is not the process covered by the Harvey patents, then it would not be the subject of the agreement of March 24, 1897, and the Carnegie Company was not 'required' to pay royalties thereunder. This is the very question at issue in the pending litigation between the United States and the Harvey Company, behind which latter company the Carnegie Company stands as beneficial plaintiff to the extent of the royalties paid by it, for the Carnegie Company is 'subrogated to the rights of the Harvey Steel Company to the amount of such royalties,' and the Harvey Company 'on the written request and at the expense of the Carnegie Steel Company' must commence and prosecute with due diligence a suit against the United States to recover the royalty due under the said Government license, and must pay over the royalties thus received to the Carnegie Company. It is obvious, therefore, that to pay these royalties is not merely to prejudge the question at issue in the present litigation, but in effect to

concede the entire claim. In my judgment, therefore, you are justified in withholding your approval of this voucher."—*Army & Navy Journal*, August 31.

TRIAL OF 8.8-INCH FACE-HARDENED NICKEL-STEEL PLATE (CAMMELL & Co.).—The test took place at Whale Island, near Portsmouth, England. The plate was 14 feet by 6.8 feet and 8.8 inches thick; and was one of a lot of plates intended for the belt armor of the British battleship Bulwark. It was supported by the usual backing and structure. Three rounds were fired from a 9.2-inch gun with a projectile weighing 380 pounds and a striking velocity of 1900 feet per second. The projectiles were Holtzer, armor-piercing, but were probably made many years ago, as the Messrs. Holtzer state that they have sold no projectiles in England in recent years. They all broke up on impact, the head of one remaining in the plate. The depth of penetration is not reported. There were no cracks and only a slight flaking of the plate about the points of impact.

TRIAL OF 6-INCH FACE-HARDENED NICKEL-STEEL PLATE (ARMSTRONG). —The test took place at Whale Island, August 22. The plate measured 6 by 8 feet by 6 inches, and was made by Sir W. G. Armstrong, Whitworth & Company, at their Openshaw works. It was submitted for test in compliance with the British Admiralty rules concerning firms which desire to be in the list of accepted makers, and was made under the supervision of an Admiralty inspector. The test consisted of four rounds with a striking velocity of 1960 foot-seconds. A fifth round was fired to ascertain the further resisting powers of the plate. At the conclusion of the firing the plate was found to be neither perforated nor cracked. The projectiles used in the test were Holtzer armor-piercing shell weighing 100 pounds, probably many years old. (See remarks on same subject in note of preceding armor test.)

GIEBELER ARMOR.—The following is from a Berlin despatch to the *New York Herald*, dated November 20: "Trials have been completed at the Royal Technical High School of a new mode of steel manufacture, declared by experts as likely to have a revolutionary effect on the world's metal industry and progress.

"It is the invention of a Mecklenburg manufacturer named Giebeler, and consists in imparting to all grades of iron a strength and hardness surpassing nearly double that of the best known Harvey, Krupp or Boehler steel, while cheapening production fifty per cent.

"Projectiles hurled at armor plate, treated by the Giebeler process and 7¾ millimetres thick, made an impression of only 1 millimetre, while Kruppized armor, four millimetres thicker, was completely punctured.

"Resistance experiments showed even more astonishing results. Attempts made by powerful machines proved the steel to possess a strength of 165 kilograms per square millimetre, when the testing apparatus collapsed.

"Among the peculiar features of the process is the increasing strength accruing as the steel grows cold. It is claimed that the process permits the metal to be worked cold or hot. Blades of the new steel chop other steel or iron into splinters, as ordinary steel cuts into wood.

"Next week the representatives of Herr Giebeler go to America with the intention of submitting the process to the great mills there."

TERNI ARMOR: TABLE OF TRIALS OF PLATES OF 67, 76, 90, 110 AND 150 MILLIMETERS.—The following is derived from tables published in the *Rivista di Artiglieria e Genio* for June, 1901.

| Character and dimensions of plate in feet. | Date of trial. | Thickness of plate in ins. | No. of shots at velocity given | Caliber of projectile in ins. | Wt. of projectile in pounds. | Striking velocity, f. s. | Velocity of perforation in ordinary steel, f. s. | Ratio of these velocities. | Ratio of caliber to thickn's | Effect on plate. |
|---|---|---|---|---|---|---|---|---|---|---|
| Patent type, 3.9×4.9 | Feb. 26, 1900. | 3.54 | 3 | 3.0 | 12.1 | 2208 | 1640 | 1.36 | 0.84 | Plate not perforated; no cracks. |
| | | | 1 | 3.0 | 12.1 | 2342 | 1640 | 1.45 | 0.84 | do. |
| | | | 1 | 3.0 | 12.1 | 2385 | 1640 | 1.47 | 0.84 | do. |
| | | | 1 | 3.0 | 12.1 | 2415 | 1640 | 1.49 | 0.84 | do. |
| Patent type, 3.6×4.9 | Feb. 26, 1900. | 3.00 | 3 | 3.0 | 12.1 | 1972 | 1437 | 1.37 | 1.00 | do. |
| | | | 1 | 3.0 | 12.1 | 2100 | 1437 | 1.48 | 1.00 | do. |
| | | | 1 | 3.0 | 12.1 | 2208 | 1437 | 1.54 | 1.00 | do. |
| | | | 1 | 3.0 | 12.1 | 2297 | 1437 | 1.60 | 1.00 | do. |
| Patent type, 3.9×4.9 | Feb. 26, 1900. | 2.64 | 3 | 3.0 | 12.1 | 1837 | 1312 | 1.40 | 1.13 | do. |
| | | | 1 | 3.0 | 12.1 | 1972 | 1312 | 1.50 | 1.13 | do. |
| | | | 1 | 3.0 | 12.1 | 2100 | 1312 | 1.60 | 1.13 | do. |
| Special type, 4.9×7.7 | May 23, 1899. | 5.9 | 5 | 6.0 | 100 | 1936 | 1345 | 1.44 | 1.01 | do. |
| | | | 1 | 6.0 | 100 | 2313 | 1345 | 1.72 | 1.01 | Plate completely perfor'd, but no cracks. |
| Special type, 5.25×6.56 | Feb. 20, 1900. | 4.3 | 3 | 4.7 | 45 | 1886 | 1365 | 1.38 | 1.10 | Plate not perforated; no cracks. |
| | | | 1 | 4.7 | 45 | 2116 | 1365 | 1.55 | 1.10 | do. |
| | | | 1 | 4.7 | 45 | 2198 | 1365 | 1.61 | 1.10 | do. |
| Special type, 3.9×4.9 | March 1, 1900. | 3.54 | 3 | 3.0 | 12.1 | 2208 | 1640 | 1.35 | 0.84 | do. |
| | | | 1 | 3.0 | 12.1 | 2342 | 1640 | 1.43 | 0.84 | do. |
| | | | 1 | 3.0 | 12.1 | 2385 | 1640 | 1.45 | 0.84 | do. |
| | | | 1 | 3.0 | 12.1 | 2398 | 1640 | 1.46 | 0.84 | do. |
| Special type, 3.9×4.9 | Feb. 26, 1900. | 3.00 | 3 | 3.0 | 12.1 | 1972 | 1437 | 1.37 | 1.00 | do. |
| | | | 1 | 3.0 | 12.1 | 2100 | 1437 | 1.48 | 1.00 | do. |
| | | | 1 | 3.0 | 12.1 | 2208 | 1437 | 1.54 | 1.00 | do. |
| | | | 1 | 3.0 | 12.1 | 2297 | 1437 | 1.60 | 1.00 | Plate completely perfor'd, but no cracks. |

All the trials took place at Muggiano.

## BOATS.

SUBMARINE BOATS: SPAR TORPEDO FOR DESTROYING THEM.—Not much has recently been heard of the British experiments with spar torpedoes which were designed to destroy submarine boats. One of the English service papers says that the Starfish, which is fitted with the apparatus, has been temporarily laid up and the trials discontinued because there are so many spies about who are endeavoring to find out all about her fittings. If she has fired many torpedoes from her spars she is probably laid up for repairs. Considering the relative strengths of hull a destroyer is more likely to be injured by a torpedo at the end of her spar than a submarine—unless the torpedo is almost against the

submarine's hull. Altogether, it would seem as if this method of attacking submarines is like Timothy Oldmixon's method of killing fleas, with the added danger to the attacker.

WELIN BOAT DAVITS.—Mr. Axel Welin, the inventor of the Welin breech-plug, now so extensively used in this country and abroad, has recently patented a boat davit which has many points of excellence. The davit, at the lower end, terminates in a quadrant of two or three feet radius, carrying a toothed rack on its circumference. At the point of junction of the davit and supporting arms of the arc, and at the same time in the center of the circle of which the arc forms part, there is a pivoted sleeve. The teeth on the davit quadrant work in a horizontal rack on the deck on which the quadrant rolls. The sleeve travels on a horizontal worm shaft, at the inner end of which there is a crank. By turning the crank the sleeve is drawn in or out, the quadrant rolls along the horizontal rack, and the head of the davit is thus lowered, or raised and inclined inboard to place a boat in a cradle on the skid beams or rail. In heavy davits the weight of the davit is taken by a smooth flange on the quadrant that projects beyond the toothed rack, which is then displaced to one side.

STEAM LAUNCHES, VEDETTE BOATS, ETC., IN FOREIGN SERVICES.—In a paper read by Mr. E. C. Carnt before the Glasgow Engineering Congress, 1901, Mr. Carnt says:

"The establishment of boats (steam) of the various classes of ships in the British navy is as follows:

| | Pinnaces. | | Barges. | | Cutters. | | |
|---|---|---|---|---|---|---|---|
| | 56 ft. | 40 ft. | 40 ft. | 32 ft. | 27 ft. | 32 ft. | 23 ft. |
| First class battleships | 2 | 1 | 1* | | | | |
| First class cruisers | 1 | 1 | 1* | | | | |
| Second class cruisers | | | | 1* | 1 | | |
| Third class cruisers | | | | | | 1 | |
| Torpedo gunboats and sloops | | | | | | | 1 |
| Surveying ships | | | | | | 1 | |

* Only when commissioned as flagships.

"With the construction in this country of warships for foreign navies, the question of equipment of steam boats is brought forward, and we find the Japanese navy adopting two 16-knot 56-foot vedette boats and an open boat, as the steam equipment for the battleship Mikasa, building at Barrow by Messrs. Vickers, Sons, and Maxim.

"The Russian Government requires two 56-foot vedette boats and two 40-foot pinnaces for a vessel building for it in France. These four boats are of steel and very fully equipped.

"The Austrian Government uses a 47-foot wooden turnabout boat with a speed of 11 knots, and are now adopting a specially fast wooden vedette boat 56 feet in length.

"In connection with the vessels recently built by Messrs. Armstrong, Mitchell and Company for the Japanese navy, four 56-foot vedette boats were required.

"Messrs. Armstrong, being always in the front where speed is wanted, asked us to consider the possibility of giving these four boats a speed of 17.5 knots under certain specified conditions.

"These required careful looking into, and the final design became a 56-foot boat with a ram bow, which increased the length about 9 inches.

"The hull was very carefully lightened, consistent with durability, where possible, and the total weight of machinery kept down to 8 tons. The engine was compound, with 8.5 inch by 18 inch cylinders; a water-tube boiler of our own type, with a working pressure of 190 pounds, was fitted.

"On our own private trial the boat gave us an exhibition of speed that we scarcely hoped for, viz., 19.5 knots. The engines developed 320 indicated horsepower at 565 revolutions, without vibration.

"A series of progressive trials were carried out with this first boat, the mean results of which are plotted on the curve attached on the official trials of the four boats, with the load conditions as specified; the mean results were as follow:

| | Revolutions. | I. H. P. | Speed. | Date. |
|---|---|---|---|---|
| No. 1..... | 548 | 297 | 18.322 | May 2, 1900. |
| No. 2..... | 540 | 297 | 18.1 | May 2, 1900. |
| No. 3..... | 538 | 302 | 18.25 | June 6, 1900. |
| No. 4..... | 543 | 292 | 18.32 | June 6, 1900. |

"These four boats are, we believe, the fastest vedette boats in the world.

"We are building a similar boat for the Austrian Government; this will shortly be completed, and we anticipate equally satisfactory results."

## BOILERS.

TRIALS OF THE MINERVA AND HYACINTH.—These two protected cruisers have recently undergone a series of competitive tests and trials, including a trip from England to Gibraltar and return. They are of the same length, depth, and nominal displacement (5600 tons), but the Hyacinth has one foot more beam. The chief differences are in the boilers and engines. The Minerva is fitted with eight single-ended boilers of the ordinary marine type, designed to furnish steam at 155 pounds, the engines developing 9600 I. H. P. at 140 revolutions. The Hyacinth has eighteen Belleville water-tube boilers, supplying steam at 300 pounds, which is reduced to 250 pounds at the engines and about 150 at the auxiliaries. The engines were designed to develop 10,000 I. H. P. at 180 revolutions.

On her original forced draft trial the Minerva developed 9891 I. H. P. and a speed of 20.34 knots; with natural draft the I. H. P. was 8221 and the speed 19.6 knots. The Hyacinth developed 10,536 I. H. P. on her full power trial, but the speed attained was only 19.4 knots. The low speed was ascribed to bad weather, but the recent trials throw some doubt on this point.

Concerning the recent trials of these vessels, an editorial writer of the London *Engineer*, in the issue of July 26, said:

"The competitive trials of H. M. S. Minerva and Hyacinth terminated on the 20th instant with the arrival at Portsmouth of the first-named cruiser at 9.50 p. m., and the second at 11.25 p. m. No official figures are available, but the statements published are, we have reason to believe, substantially accurate. It would be waste of space to recapitulate the

history of the experiment. Our readers who are not fully informed we must refer to our recent impressions. Last week we illustrated both ships, and gave their leading dimensions. During the run from Plymouth to Gibraltar the engines of both vessels were worked as nearly as possible at 7000 horsepower. Each ship reported herself on arrival, and then continued steaming with the intention of emptying her bunkers, and so ascertaining her endurance at the stated power. The Hyacinth steamed altogether for 103.5 hours, and the Minerva for 150 hours. How much coal the Hyacinth had on board then we do not know. She was driven into Gibraltar, because her boilers leaked so much that the fresh water feed could not be maintained, the evaporators being overpowered. The Minerva lost about two hours repairing machinery. It is stated that at 4 p. m. on Wednesday the 17th, the signal was made, 'Light up and proceed to England.' Three-quarters of an hour later the Hyacinth was steaming at 18 knots. At 5.15 p. m. the Minerva was steaming at full speed. On the run home fogs were encountered three times, by which the ships were delayed. But always the Minerva was the faster boat of the two. A boiler tube burst on board the Hyacinth, and a fireman was so severely scalded that he had to be sent to Haslar Hospital. Both ships are to join at once in the manœuvres. We may incidentally mention here that on the run out Vice Admiral Sir C. E. Domville, Mr. J. Milton, and Mr. Wood were on board the Hyacinth, and Mr. Bain, Mr. List, and Commander M. E. Browning were on board the Minerva. Before the run home they changed ships.

"A consideration of the circumstances of the trial shows that the results were curiously typical. In every way they support the contention of those who advocate the superiority of the Scotch boiler over water-tube generators; but they do more than this. They go to show that the recent high-pressure practice of the Admiralty is in no wise better than the older system. It will be remembered that the Minerva is comparatively an old vessel, built in 1895. She has triple-expansion engines with cylinders 33 in., 49 in., and 74 in., by 3 feet stroke. The boiler pressure is 155 pounds; revolutions, 140; indicated horsepower, 9600. She is at all powers faster than the Hyacinth; precisely why no one knows. Carefully conducted tank experiments proved, we understand, that what may be called the tow-rope resistance of the two cruisers is about the same. No doubt the defect of the Hyacinth lies in the way in which her power is applied, that is to say, in her machinery. The performance of the Minerva was quite uneventful. The only defect manifested was the breakage of the bolt of an eccentric strap, and the consequent bending of one of the straps. The defect was made good with spare gear in two hours. The ship was quite ready to start again on her homeward run the moment her bunkers were filled.

"Leaving the Minerva for a moment, we turn to the Hyacinth. During the first hours of the run out all went well. Then the loss of water began. The evaporators can supply between six and seven tons of distilled water per hour; but this was insufficient to make up the loss. A very curious feature of this loss is that it was found impossible to trace it to its source. The connections and pipes seemed tight, water did not run into the furnaces, nor was it found in the bilges. The loss was not due to priming, of course, because the water would have reappeared in the hot well. The only explanation is that a multitude of very small leaks are equal in effect to one or two large leaks, and that the water

was evaporated and went up the chimneys. A most careful overhaul took place at Gibraltar, and there everything was tested by the hydraulic pump. Not satisfied with this, the ship was taken out of harbor and run for twelve hours to make certain that every joint was tight. This being done, she returned to harbor; fires were drawn and the boilers cooled down.

"We now come to the run home. The statement that within less than two hours from the receipt of the signal to light up, the Minerva was at full speed may appear incredible. It is, however, perfectly true. No wonder will be felt that the Hyacinth with water-tube boilers should get steam quickly, but the performance of the Minerva comes as a surprise. It was not a case of banked fires. While in harbor one boiler out of the eight was under steam to supply electric light, etc. On the day before the return voyage began both ships were moved into the outer harbor, or roadstead; and as there was some wind, the pilot refused to move the Minerva with only one boiler going. Steam was, therefore, raised in two other boilers. As soon as the vessel was moored the fires were entirely drawn, the steam blown down through the condensers, the smoke-box doors opened, and the boilers cooled down for about twenty-four hours. When the order to light up came one boiler was carrying 150 pounds; in two boilers the temperature of the water was at 190 degrees Fahrenheit; in the five remaining boilers it was 90 degrees, that being the temperature of the stokehold—not much in excess of the air on shore. The engines were still warm. Both ships started the moment the engines could give them steerage way. It is no matter of wonder that the Hyacinth should get away quickly, but the fact that the Minerva was so little behind cuts the ground from under the feet of those who maintain that the Scotch boiler is too slow for naval purposes. The draft was never forced; it was assisted by the fans, the pressure not exceeding about half an inch. No doubt the result was secured by boiling the top water, the bottom water remaining comparatively cold. If the hydrokineter had been used several hours would have been lost. This is by no means a solitary instance of what can be done in an emergency. The boilers were in no way injured. On the run home they were properly treated. They were never forced beyond their legitimate power—8400 indicated horsepower—which they can attain with assisted draft.

"As to the Hyacinth, we are told that some anxiety was felt about her Belleville boilers; and this seems to have been justified by the deplorable accident to which we have referred. We have said that the performance of the two ships is opposed to the theory that the high pressures recently adopted by the Admiralty are economical. The Hyacinth has four-cylinder triple-expansion engines, the cylinders being 26 inch, 42 inch, 48 inch and 48 inch, with 30 inch stroke, maximum revolutions 180. It is officially admitted that the engines of the Minerva are more economical, although it is claimed that the boilers of the Hyacinth evaporate about 9 per cent more water per pound of coal. So far as can be said, in the total absence of official figures, it appears that the Minerva burns less coal per mile, other things being equal, than the Hyacinth. The engine friction of the latter, because of the short stroke, high speed, and high pressure—250 pounds—must be greater than that of the Minerva's machinery. The coal burned for all purposes, expressed in terms of indicated horsepower, was as nearly as possible the same for both ships, just under 2 pounds.

"The history of the trial is, as we have said, typical. We have the steady old Scotch boilers, fairly used, and doing their duty perfectly in the one vessel, and in the other we have the Belleville boiler doing as it would seem it always does when pressed. The ship could hardly reach Gibraltar at seven-tenths of her full power, the old trouble, leakage, driving her into port; and be it remembered that the Hyacinth is comparatively a new vessel—1898—that her machinery has been in charge for many weeks of Mr. Gaudin, and that nothing was left undone to make her a success. The Minerva, on the other hand, working up to a higher fraction of her full power, gave no trouble whatever, and beat the Hyacinth in speed.

"A statement appears in the pages of a contemporary, to the effect that when it was found that the Hyacinth was being outpaced by the Minerva, her Belleville boilers were forced up to 10,000 horsepower, yet the ship went no faster through the water: 'The Hyacinth is much more powerfully armed than the Minerva, but her 2000 additional horsepower gives her no appreciable advantage. The trial has demonstrated that the reported speed of the Hyacinth class is fictitious, for, owing to causes which cannot here be inquired into, it is now known that any effort to attain more than 9000 horsepower is labor and fuel wasted. Thus at 7000 indicated horsepower the speed of the Hyacinth was 17.9; at 9400 it was 19 knots; and at 10,000 indicated horsepower it was still 19 knots.' This is only partially true. The particular result named seems to have been due to the state of the weather, and to no other cause. Both ships are affected by rolling and to an extent which deserves investigation. One type of roll appears to have a greater effect in reducing speed than any other; why, no one, so far, seems able to explain.

"The result of the whole trial is precisely agreeable to our forecast. It has added nothing very new to the existing stock of knowledge. The Minerva's machinery behaved just as it has always done. Her Scotch boilers maintained their reputation, and showed once more by how little the Scotch boiler failed a few years ago, and then only as the result of bad design and improper management. The Belleville boilers of the Hyacinth again did just what was to be expected. It will be remembered that we said that the only novelty to be anticipated in their performance would be that they had gone to Gibraltar and come back without a breakdown. This novel experience was not provided. We venture to think that in the light of the results of this trial the admiralty may feel thoroughly justified in proceeding to fit the ships of the navy with properly designed cylindrical boilers, until such time, say five years hence, as they have reason to believe that a really satisfactory water-tube boiler is available."

In the *Engineer* of August 30, the following appears:

"We publish this week the major portion of the text of the parliamentary paper 'Return of the Particulars of the recent Sea-trials of the Minerva and the Hyacinth,' ordered by the House of Commons to be printed on the 7th of August. This report, it will be seen, supplies little information in addition to that which was given in THE ENGINEER, and in its pages only, on July 26th. We have the facts and circumstances of the run out to Gibraltar and home given in detail. They will be or will not be found instructive according to the way in which they are used. If, for example, the Admiralty refuses to draw deductions which we think palpable, then there is no instruction for the Board in the

report. For those who, like ourselves, take it as a plain statement of simple facts, it will be at once interesting and useful, in the sense that it will help us to arrive at some definite conclusions concerning boilers for the Navy, or will confirm the accuracy of the deductions which we have ourselves drawn.

"In the first place, we learn that the principal argument which has been used against the retention of the Scotch boiler in ships of war has no real foundation. It is not true. It has always been maintained that steam could not be raised to the working pressure in the cylindrical boiler with safety in less than about six hours, whereas it is of great importance that steam should be available in less than an hour. The statements made on this subject have been tacitly accepted as true by the outside public. We do not except engineers; least of all do we except ourselves. In the mercantile marine it is always the practice to get up steam as slowly as possible, six hours being regarded as a minimum time for the operation. The idea is that, working in this way, the boilers are spared injurious stresses by being gradually heated up. In merchant ships there is no reason for hurry, and the experiment of getting up steam as fast as possible does not appear to have been tried at all, or, if tried, the results have not been made public. There has been general ignorance on the subject. In any case, the Admiralty have apparently not tried the experiment, although it was one of the most interesting that could be carried out. The water-tube boiler possessed, it was claimed, the transcendent merit that steam could be got up in it in about one-fifth of the time possible with the Scotch boiler. The trials of the Minerva and the Hyacinth have settled this question at all events, for ever. It will no longer be possible to defend or advocate the water-tube boiler on this ground. We have already said that there was very little difference in the time spent in raising steam in the two ships. We have now the precise figures before us. At 4.27 p. m. on the 17th of July the ships received simultaneously the order to light up and start for Portsmouth as soon as possible. The Hyacinth had two boilers under steam, and her engines had been warmed up. At 5.20 p. m., that is to say, in fifty-three minutes after receiving the signal, she was steaming at 7000 indicated horse-power. The Minerva had one boiler alight out of eight at 4.27 p. m. Her engines had been warmed up. We have already given the temperature of the water in her boilers. At 5.16 p. m., that is to say, in four minutes less time than the Hyacinth, she was steaming at full speed also, and we learn that her boilers, which have seen a good deal of service, were not one penny the worse. The idea that steam could not be raised quickly in Scotch boilers is nothing more than a bogey, a thing to frighten engineers with—a mare's nest in short. No mention is ever made of the circumstance that large engines cannot be warmed up in less than two hours, so that period must always be available for getting up steam, no matter what boiler is used, and it is ample for the Scotch boiler, at all events in emergencies. Again, we find that the Hyacinth is far from being as economical a ship as the Minerva. It is not necessary to refer to the consumption of coal per horse-power per hour. We have the far more instructive case of two ships very similar in dimensions, making a given voyage at much the same speed. The Hyacinth burned 550 tons, the Minerva 450 tons. The Hyacinth's engines developed, it is true, about 1000 horse-power more than those of the Minerva; but for some reason

unexplained they did not propel the ship any faster. Admiral May, the Controller of the Navy, says, 'The extra horse-power must have been absorbed either in the engines, or on the main shaft bearings, or in the hull. It is possible that the shape of the hull may have had something to say in the matter, but former trials do not bear this out.' The experiments carried out by the Boiler Committee, before the ships went to Gibraltar, gave results showing that while the Belleville boilers, with feed heaters were rather more economical than those of the Minerva, that the engines of the latter required less steam per horsepower per hour. It is well to bear in mind that not the Belleville boilers alone, but the whole engineering policy of the Admiralty is being tried. It has to be decided whether 250 lb. working pressure is really better than 150 lb. This question is scarcely less important than the comparative merits and demerits of different types of boilers. Nothing is easier than being led astray concerning the true nature of the points to be settled. Thus it may be claimed that the Belleville boiler is lighter than the Scotch boiler, but the advantage, such as it is, can be lost if the necessary evaporators required to make up the waste of water are very large, and therefore very heavy. We must take into consideration not so much the weights of different items, as the total weight of all the appliances, coal, and water, required to convey the ship from one port to another port at useful speeds. So far we have failed to find that the Belleville boiler and high-pressure steam give results in any shape or way, and tested by any legitimate method of using figures, which are better than those obtained from the Scotch boiler and the more moderate steam pressures hitherto in vogue; and the tests of the Minerva and Hyacinth only confirm the soundness of the belief that there is not one point or feature in which the new system is not inferior to the old.

"That portion of the report which deals with the condition of the boilers when examined at Portsmouth will be read with interest. It seems that a large number of tubes in the boilers of the Hyacinth were bent. The boiler known as 'No. 10' had fared very badly, the fusible plugs were melted out, nine tubes were bulged, one was burst, with an opening 8in. by 3in. The boilers required, as we stated in our former article, an enormous quantity of water to make up feed. Drinking water, besides the legitimate store of fresh water, was used, and this with evaporators working as hard as they could be driven. The puzzle is what became of the water. The Committee have no explanation to offer. The engineers of the dockyard have found nothing but a number of 'slight' leaks. How these can account for some fifty or sixty tons of water per day is more than anyone seems disposed to say. The latest information available is to the effect that the Admiralty have asked Messrs. Delauney, Belleville and Co., of Paris, the patentees of the Belleville boilers, to send over two representatives to assist in making a survey of the Belleville boilers of the cruiser Hyacinth, and to suggest a remedy for preventing the excessive loss of feed-water. If the water finds its way into the furnaces, its evaporation represents a dead loss of fuel, to say nothing of other evils entailed. The boilers of the Minerva gave no trouble whatever up to the last few hours, and then the draught became bad because of the formation of 'birds' nests,' as the curious rings of solidified coke formed round the tube ends are called. Mr. Yarrow, plagued with these rings years ago in the days of locomotive torpedo-boat boilers, carried out experiments which proved that the formation of

these rings is due to the presence of a small percentage of iron in the coal. It is not often met with in Scotch boilers unless they are pressed pretty hard. Very little importance need be attached to this birds' nesting. Under ordinary circumstances the tubes would have been swept in the usual way, and the nests broken off. At the worst they involved nothing more serious than cooling the boilers enough to let men pass into the back uptake and sweep them off with a wire brush. They are, as we have said, due to impurities in the coal; and something of very much the same kind takes place in water-tube boilers, ridges of coke forming along the tubes, and choking the air spaces. Finally, we may say that the report contains several tables, mostly of very small value, which we have not deemed it necessary to reproduce."

The *Engineer* continues the remarks about the trials in the issue of September 6 as follows:

"We commented last week on the experiments which have been made with the two cruisers Minerva and Hyacinth; so have several of our contemporaries. We find it expedient, therefore, to say a few words more about these vessels, and the lessons to be drawn from their performance. Some confusion of utterance is evident; some lack of appreciation of the facts, and the bearing and teaching of the facts; a tendency to exalt the value of those points which tell in favour of the Admiralty, and a desire to understate those which tell against its policy. It is necessary under these conditions to set the facts in their true light, neither exalting nor depreciating their significance. In the first place, it is essential that the word 'if' should be eliminated. 'If' this had not happened then the result would have been different. 'If' this, that, or the other had occurred then right would have been wrong, and wrong right, and so on. All this may be useful, and no doubt is useful in its proper place; but the word 'if' is certainly not in its proper place when it is used to obscure issues, or lead up to erroneous deductions. An example of the misuse of the little word is found in the argument that possibly 'if' the Belleville boilers of the Hyacinth had been built by a French firm the workmanship would have been so much better than it is assumed to be, that no leakage would have taken place. Again, it is more than hinted, of course, 'if' an English firm chose they could turn out as good work as any French firm. The implication here is worse than the original suggestion.

"Let us, leaving these things, come down to hard facts as set forth in the official documents. We have two ships, very much alike as far as the hulls, weight of armament, and dimensions are concerned. The machinery of the Minerva represents probably the best that could be done under the old system; that is to say, with Scotch boilers, triple-expansion engines, and 155 lb. pressure. The ship has seen a good deal of service, and her boilers are no longer new. The Hyacinth is, on the other hand, the embodiment of the latest system of naval propulsion—she has short-stroke, high-speed engines, Belleville boilers, and 250 lb. pressure. To talk about 'if' is simply disingenuous in connection with these two cruisers. We have nothing to do with the 'might have been.' So far as they go they are the embodiments of two different systems of marine propulsion. These two systems could not possibly be tried more fairly. We cannot even think of conditions that would be more likely to give an instructive result from experiment. The new system has failed as compared with the old system. We are told, by way of excuse, that

'if' there had been more experience with the new system the results would have been different. There is no evidence whatever that any amount of experience could have modified the results. With 10,000 indicated horsepower the Hyacinth cannot steam as fast as the Minerva with the same displacement working at 8400 indicated horsepower. It is suggested by the Admiralty that the frictional resistance of the high-speed high-pressure machinery is so much greater than that of the Minerva's low-pressure low-speed—by comparison—machinery that the loss is explained. The hypothesis seems to be in accordance with the facts. The only result of further experience, pushed to its logical conclusion, would be a reversion to the older type of boilers and engines for the Hyacinth. For the last six years we have continually been told the same story—'There are difficulties. If we had more experience, they would be surmounted.' We shall hear the same story, we think, for another decade. The most sanguine believer in the fitness of Belleville boilers, and high-speed engines, and great pressures for cruisers, must have been shocked by the results of the Gibraltar run. It is quite impossible to assert with any expectation of being believed by competent authorities, that the Hyacinth is an improvement on the Minerva. In saying this, it must be very clearly understood that we do not assert that because the Belleville boiler has not been a success, all water-tube boilers must be failures. We do assert that the trial of the Minerva and the Hyacinth tell us nothing, supply no information whatever on this point. Because in this experiment Belleville boilers have been badly beaten, we must go on to argue that no other form of water-tube boiler could have succeeded. About this question—a very important question, no doubt—the runs to and from Gibraltar are absolutely silent. It seems absurd to insist on this limitation, but it is necessary.

"It is not to be disputed that the boilers of the Hyacinth could not be kept supplied with water, and that they suffered from the work they had to do. But, it is argued, the cylindrical boilers were just as bad. The Admiralty ferrules were much worn, and the retarders were wasted somewhat at combustion chamber ends. The brickwork also had suffered. It is not necessary to say more than we said last week about the boilers of the Hyacinth. We have already explained that the bird-nesting, of which so much has been made, is due to the presence of a little iron in the coal. The rings are quite easily removed. A stout wire tube brush driven in from the front end will knock them off. No trouble is experienced with them in fast Atlantic service, nor is there any really to be feared from them in the Navy. That the Admiralty ferrules were wasted is quite likely. They have probably seen a great deal of service. The retarders are neither more nor less than pieces of hoop iron twisted into a spiral and put one into each tube. The cost of each is a few pence. No intelligent engineer who understands boilers can be misled for a single instant as to the true meaning of the reports on the condition of the boilers of the two ships which were published in our last impression. The result of the whole trial is the lesson that the Hyacinth is quite incapable of steaming at much over 6000 indicated horsepower for more than 150 hours, owing to the waste of water, and apparently the bending and bulging and splitting of tubes. The Minerva, on the other hand, could steam at that power until all her coals were gone, and would be ready to run again for a similar period as soon as her bunkers were refilled, no repairs of any kind being needed that could not be carried

out in two or three hours; while, if put to it, she could steam for 1200 miles or so at 8700 indicated horsepower. These are plain statements of incontrovertible fact which tell their own story.

"Before the Hyacinth and the Minerva ran to Gibraltar, a series of experiments were carried out by the Committee to test coal consumption. The results are given in a table in the report. This table we have not reproduced because the figures are in various ways involved and confusing. Wise men try one thing at a time, if they can. Either the Committee is not composed of wise men, or they could not. Thus we have the Hyacinth working with closed exhaust and low-pressure jackets, and with open exhaust and 'with jackets,' compared with the Minerva working with open exhaust and jackets. It may, perhaps, be well to explain what the words 'closed exhaust' mean. Nearly all the auxiliary engines in men-of-war are non-compound, and are very wasteful when worked with high-pressure steam. When the main engines are working at 250 lb. a reducing valve lets down the pressure for the auxiliaries to 150 lb., but they are, of course, still wasteful. The closed exhaust is by way of compounding them. They all exhaust into a closed system loaded to about 28 lb. per square inch. The exhaust steam is thence led into the evaporators, the low-pressure receiver of the main engines, or the auxiliary condensers. If a little make-up feed-water is required, then, instead of live steam being put into the evaporators, the auxiliary exhaust is used. Of course, this cannot be done when the full-power of the evaporator is required, for then full pressure must be used. The Minerva is not fitted with closed exhaust. The figures given in the table are so mixed that nothing of moment can be made of them. We do not know whether the consumption of fuel is for all the auxiliary machinery, as well as for the main engines, or not. We cannot tell from the tables whether the water lost is credited as though evaporated in the boilers or not. We are told that the Minerva used .484 lb. of water per horse per hour for jackets and make-up feed, and that of this 0.2 lb. went for feed and 0.284 lb. for the jacket; but this is so small a jacket condensation that there must either be some errors in the figures or else the jacket is nearly useless. No doubt valuable data exist concerning these experiments; but before they can be used to any good purpose they must be re-cast in a form different from that of the table appended to the report."

The following is the statement of the President of the Boiler Committee, giving the events of the two runs:

"Representatives of the Boiler Committee, consisting of the President, three members, and the joint secretaries, embarked in H. M. S. Hyacinth and Minerva at Devonport, about 2 p. m. on July 6. The ships sailed at about 3 p. m. on that day, and started working up to 7000 horsepower. It was intended that the ships should maintain 7000 horsepower till all the coal, except that in the reserve bunkers (82 tons), was exhausted. By 3.45 p. m. the revolutions in the Hyacinth were 152 per minute and the horsepower 6994, and the trial was considered to have started from that time. The Minerva's trial commenced at 4 p. m. The Minerva soon showed that she was the faster ship, and steadily drew away from the Hyacinth. By midnight on the 7th the Minerva was about 4½ miles ahead.

"When passing through the Straits of Gibraltar, early in the morning of the 9th inst., a fog was encountered; the Minerva eased down for 55 minutes, while the Hyacinth had to ease down for two hours. On running out of the fog both ships again worked at 7000 horsepower.

"At 4.30 p. m. on July 10, a bolt of the ahead eccentric strap of the starboard intermediate engine of the Minerva broke, and the starboard engines had to be stopped; the port engines continued running. The strap was found to be damaged, and had to be replaced by the spare one. This work was carried out in about two hours, and at 6.40 the starboard engines started working again, and were worked up to the required power.

"It had been arranged that the water in the reserve tanks of both ships should be used as the only make-up feed-water until it was reduced to 20 tons, in order that the amount of make-up feed used per day might be accurately determined. When the reserve had been reduced to 20 tons, this water was to be kept intact in the tanks ready for use in case of emergency, and all make-up required was to be obtained from the evaporators.

"Special reserve tanks had been fitted in the Hyacinth to hold about 100 tons; this, added to the original reserve tank stowage, gave a total reserve tank stowage of about 140 tons. The total reserve stowage of the Minerva was about 170 tons.

"When the amount was reduced to 35 tons in the Hyacinth, the staff engineer asked to be allowed to start the evaporators on account of the difficulty of getting the water out of the tanks by the special pump fitted for these trials. Two Weir's evaporators working with exhaust steam were started at 5.30 a. m. on the 9th, and the two Normandy's during the afternoon of the 10th.

"At 1.15 a. m. on the 11th of July, the staff engineer of the Hyacinth reported the engines would have to be eased on account of the large loss of water, and the trial was abandoned from 1 a. m. All the evaporators were working at this time, and in addition to the water from the reserve tanks, 25 tons of drinking water had been used for boiler make-up. The Hyacinth returned to Gibraltar at slow speed, arriving there on the evening of the 11th.

"The Minerva continued steaming at 7000 horsepower till 11 p. m. on the 12th, at which time there were still 39 tons of coal in the bunkers, not including the reserve, and 20 tons of water remained in the reserve tanks.

"The average horsepower of the Hyacinth was 7047 for 103.25 hours, with a coal consumption of 1.97 pounds, and the distance run was about 1810 miles at an average speed of 17.6 knots; the Minerva's horsepower was 7007 for 147 hours, with a coal consumption of 2.06 pounds, and the distance run was about 2640 miles, at an average speed of 17.96 knots.

"On the night of the 10th of July, flaming occurred at the after funnel of the Hyacinth, but no flaming is reported from the Minerva. On the examination of the Minerva's boilers after arrival at Gibraltar, it was found that the openings in the Admiralty ferrules were seriously choked, the size of the openings, in some cases, being reduced to about one-third the original.

"The boilers and engines in both ships worked well on the way out, with the exception of the eccentric strap bolt of the Minerva, and a number of leaks which developed in connection with the boilers of the Hyacinth; these latter appeared to become worse after the engines were suddenly eased on entering the fog on the 9th, on which occasion the pressure of the boilers became sufficiently high as to lift the safety valves.

"The loss of water in the Hyacinth was at first attributed to leaky

feed suction pipes, but during the stay at Gibraltar these pipes, the feed and hot-well tanks, and the boilers and boiler blow-outs, were water-pressure tested, and no leaks beyond those already known to exist in the boilers were discovered.

"As no serious leaks could be discovered during the stay at Gibraltar, the leaky joints in the Hyacinth's boilers were remade by the ship's staff; and on Tuesday, the 16th, the ship was taken out for a run at about 7000 horsepower, to test the amount of feed water being lost. This was found to be at the rate of about 55 tons a day, from the records of a six hours' run; after being under way three hours, the engines were eased by order from the deck, and the boiler safety valves allowed to blow off freely, so as to reproduce the circumstances that occurred in the fog on the 9th July. The rate of loss of water was calculated from a steady three-hours' run before easing and a steady three-hours' run after easing, a fresh start being made after easing down, and the water lost during the period the safety valves were allowed to blow being neglected. On return, the Hyacinth anchored in the bay at 4.30 p. m., and all fires were drawn except those in two boilers. The Minerva steamed from the Mole with three boilers alight, and anchored in the bay at about the same time as the Hyacinth anchored; fires were drawn from two boilers.

"Gibraltar Dockyard made a spare eccentric strap for the Minerva, and supplied it to the ship on the morning of the 17th.

"At 3.30 p. m. on the 17th, the Committee embarked; at this time the Hyacinth had two boilers alight for auxiliary purposes, and the Minerva one.

"The boilers of both ships had been thoroughly cleaned during the stay at Gibraltar.

"Before the ships began the homeward run, a communication as follows was handed to the captain of each ship:

"'On the responsibility of the ship's officers, a large quantity of fresh water for boiler make-up has been taken as a precautionary measure in the double bottoms of the Hyacinth, and in the extra reserve tanks of both ships. These latter tanks were fitted specially for the outward trials, and do not form a part of the ship's ordinary fittings. It is to be understood that, except the amount originally allowed to each ship (about 40 tons in the ordinary reserve tanks), this is to be used in cases of emergency only during the homeward run. The evaporators, if they have not been in use before, are to be started as soon as the 40 tons mentioned have been used up, and then the make-up required is to be obtained from the evaporators. If the evaporators are unable to supply the whole of the make-up required, their use at maximum obtainable output is to be maintained, while the remaining water used may be taken from the reserve tanks.'

"In the case of the Minerva, the expenditure of the 40 tons in question was not exceeded, but the Hyacinth had used the 40 tons by 5.15 a. m. on the 20th, though all her evaporators had been working practically all the time.

"At the conclusion of the trial it was reported that 98 tons of water had been used from the reserve tanks of the Hyacinth as make-up feed, in addition to that made by the evaporators.

"The ships were informed that on the signal being made at an unknown time after 4 p. m. by the senior officer at Gibraltar, fires were to be lighted in the boilers not at work, and the ships were to proceed

to Portsmouth as fast as possible. The signal was actually given at 4.27 p. m.

"The engines of both ships had been warmed through by steam from the boilers alight.

"At 4.30 p. m. the Hyacinth's engines were worked slowly in accordance with orders from the deck, steam being supplied by the two boilers which were alight. At 4.52 the after group of boilers were connected up. At 5.05 the forward group and at 5.09 the middle group were connected up, the steam pressure being 200 lb. At 5.20 p. m. the Hyacinth was proceeding at 150 revolutions per minute, the horse-power being nearly 7000.

At 4.30 p. m. the Minerva's engines were worked slowly in accordance with orders from deck. The boilers were connected at the following times:

"2nd, 4.55; 3rd, 5.02; 4th, 5.07; 5th and 6th, 5.10; 7th, 5.12; 8th, 5.15.

"The engines were working up to full power at 5.16 p. m., but had to be eased several times between 5.30 p. m. and 8 p. m., on account of eccentric straps warming up.

"At 5.15 a. m. on the 18th the Hyacinth was about six miles ahead of the Minerva; but, both ships running into a fog, the Minerva ran up to the Hyacinth, and at 9.30 a. m. on the 18th, on emerging from the fog, the ships were nearly level, the Minerva being slightly ahead. Both ships then worked up to the maximum power, but throughout the day the Minerva was stated to have gained one-third of a knot an hour on the Hyacinth. At 7 p. m. another fog was encountered, and the ships went slow through the night, keeping close to each other.

"At 9 a. m. on the 19th they were again level. The fog having cleared, both ships went on again, and during the day the Minerva gradually drew ahead, and was stated to be going a quarter of a knot an hour faster than the Hyacinth. At 7 p. m. the Hyacinth again eased, owing to fog, and went slow till 5 a. m. on the 20th, the Minerva being out of sight ahead.

"The Hyacinth then steamed at over 9000 horsepower till 6.10 p. m. on the 20th, when the fires of No. 10 boiler were drawn on account of a burst tube; one man was slightly injured by the steam and hot coal.

"At 9.50 p. m. the trial in the Hyacinth finished, the ship being then off St. Catherine's, and she arrived at Spithead at 11.30 p. m. The Minerva had passed St. Catherine's at 8.20 p. m., and anchored at Spithead at 9.45 p. m.

"The coal used by the Hyacinth on the way home was stated to be 550 tons; by the Minerva, 451 tons.

"The Hyacinth's evaporators were all in use practically the whole time, but the Minerva used hers but little.

"The maximum power developed by the Minerva was about 8700 horsepower, while that developed by the Hyacinth was nearly 10,000 for at least two hours, during which time the Hyacinth did not perceptibly gain on the Minerva. The Hyacinth's average power when running clear of fog was about 9400, and the Minerva's about 8400 horsepower.

"From the results of the outward run it appears that the radius of action of each of these vessels at 7000 horsepower, as far as the coal is concerned, should be, roughly,

Hyacinth, 2930 miles; Minerva, 3000 miles.

"No difficulty was experienced in either ship at any part of the outward or homeward runs in keeping up a sufficient supply of coal to the fires.

COMPTON DOMVILE, Vice-Admiral,
July 26, 1901. President of Boiler Committee."

## COALING SHIP.

COALING BRITISH SHIPS AT SEA.—The recently-introduced arrangement for coaling from a collier at sea did not prove advantageous during the evolutions of the combined squadron off the coast of Portugal. The Royal Sovereign only took ten tons per hour in calm and favorable weather. On the following day the Empress of India attempted the operation while the sea was somewhat disturbed, and was unable to take any fuel from the vessel.—*Army & Navy Gazette.*

## COAST DEFENCE.

UNITED STATES: SHIELDS FOR GUNS: PNEUMATIC GUNS.—The proceedings of the Board of Ordnance and Fortification at its meeting of June 6 have just been approved by the Secretary of War. In many respects this meeting of the board was the most important which has occurred for many years. The thickness and size of shields for rapid-fire and coast-defense guns were decided upon; it was unanimously decided that dynamite guns for firing high explosives were unfitted for modern purposes, and the plan for the forthcoming test of mortar batteries at Portland, Me., was approved. For 6-pounder and 15-pounder rapid-firing guns the board decided that the shields for the protection of the gunners should be one and one-half and two inches thick, respectively. They are to be of the simplest form practicable to afford the necessary protection. The larger guns of 8, 10 and 12 inches caliber, mounted en barbette, are to be provided with shields of a thickness not exceeding 4½ inches. The shields for all guns shall be made of modern face-hardened armor, and shall be of a uniform thickness for the different types. In order to determine the amount of protection afforded, the best method of securing the shield to the mount, and distributing the effect of the impact of the projectiles on the manœuvering of the gun and mount, the board has made an allotment of $8000 to make tests with regulation shields mounted on dummies.

The board unanimously decided that dynamite gun batteries are obsolete in view of the recent developments in means of defense. This means that we are to have no more of these batteries beyond those now in the service. As a matter of fact, the dynamite gun did not use dynamite for firing high explosives, but wet gun cotton. The experience of past years has distinctly shown that batteries of this kind do not meet the requirements of the service. The Navy has had the like experience and has practically abandoned dynamite guns.—*Army & Navy Journal*, June 13.

## CONSTRUCTION.

NOTE.—Under this head will appear notes on Design, Materials, Sheathing, etc.

JUPITER STEEL.—Considerable attention has recently been paid to experiments with this steel. The following is derived from an article in the *Scientific American:*

"The manufacture is carried on under several patents granted to Andres G. Lundin, and the composition of the steel, the method of the manipulation in the furnace, the special materials and careful work in the molding, have resulted for the first time in the history of the art in the production of a cast steel which, in tests carried out at the navy yard at Boston, has proved to possess qualities of strength and ductility equal to those of forged steel. These excellent results are obtained, moreover, with but little sacrifice of the high economy which distinguishes ordinary cast steel. Perhaps the best evidence of its remarkable qualities is found in the fact that cold chisels and hatchets, cast to the finished shape in this steel, will, after being put on the emery wheel, perform their work and hold their edge with perfect satisfaction; and one of the most striking evidences of what might be called the wrought-steel qualities of this cast-steel product is the fact that at the request of the writer two of these cast chisels were placed end to end and welded with perfectly satisfactory results.

"The stock consists of a large variety of mild steel scrap, such as boiler plate clippings, borings from the gun shops, the scrap from sheet-steel works, old crankshafts, and, indeed, any kind of steel that possesses the necessary composition to make up the furnace charge. The melting is carried on in a large furnace house, the steel for the smaller castings being melted down in crucibles and the metal for the larger castings being melted in 25-ton Siemens' open-hearth furnaces. The preparation of the furnace charge and the introduction of the various ingredients during the furnace treatment is carried out in the manner and proportions indicated by the following example, which will serve to show the proportions, but not, of course, the actual amounts which are treated at any one time in the furnaces, the latter having, as we have said, a capacity of 25 tons.

"A hundred pounds of steel scrap is placed in a crucible in the furnace and melted to a boiling point of about 4000 deg. F. When the boiling point has been reached, from 1.5 to 2.5 pounds of ferrosilicon, containing 12 per cent silicon, is introduced into the molten metal. As soon as the ferrosilicon has melted, 2 to 8 ounces of ferromanganese, containing 80 per cent manganese, is mixed with 3 pounds or less of aluminum, and this mixture is introduced into the molten metal, where it quickly melts. After the resulting composition is thoroughly melted, it is tapped into ladles, carried to the various flasks and poured into the molds.

"In tests recently carried out by the government this steel has shown a tensile strength of 67,300 pounds to the square inch, and an elongation of 25 per cent in 8 inches, while in the bending tests a one-inch-square bar of this cast steel was bent cold through an arc of 93.5 degrees without fracture. As a result of these excellent qualities, Jupiter steel is finding a wonderfully wide range of usefulness in the industrial arts. Thus, the shipwork which is being done for the government and private shipbuilding firms includes the rams for the new United States battleships Rhode Island and New Jersey, each of which castings will weigh 43 tons,

and the stern frame, keel, and sternpost for the same vessels. Other castings include shoes for marine engines, engine thrust bearings, knees, and many small parts ordinarily made of forged steel for the interior construction and fittings of ships, engine beds, engine cranks, crossheads, gear wheels, etc. The castings for the battleships Rhode Island and New Jersey alone will equal in weight over a million pounds."

MAGNALIUM.—"On several occasions we have remarked the difficulty of obtaining any precise information about the properties of this comparatively new alloy of aluminium. An article on the subject, however, has recently been printed in one of the German technical papers, from which we are able to extract the following particulars. Under the generic name of 'magnalium,' alloys are now prepared containing between 10 and 25 parts of magnesium per 100 of aluminium. With 10 parts of magnesium the material is said to have the mechanical properties of rolled zinc; with 15 parts to resemble cast brass; and with 20 or 25 parts of magnesium to imitate hard drawn brass and the various grades of red bronze. Dr. Mach, the inventor, finds that sodium, carbon, and nitrogen in the original aluminium cause the alloys to be of no value; and this probably explains why the earlier attempts made by Wöhler to produce a useful alloy of these two metals were quite unsuccessful. Additions of tungsten, nickel, and copper, are not harmful to magnalium, except in so far as they increase the specific gravity of the alloy. Ten to 15 per cent. of antimony has the advantage of raising the melting point from 700 deg. Cent. to a white heat. When less than 10 per cent. of magnesium is mixed with the aluminium, the alloy rolls well and is specially suitable for manufacturing sheet and tube. Large quantities of magnesium adapt it better for casting purposes.

"The mechanical properties of magnalium have been investigated by Herr Kaempfer. The alloy turns well, yielding long coherent shavings; it can be drilled and milled readily, and does not slip or bind. Under the file it resembles soft brass; it does not clog, and the finest cut files can be used. It takes a high silver-white permanent polish; and it can be easily blackened. Its hardness is greater than that of pure aluminium, for it cannot be cut with a knife; so that cock-plugs, spindles, gear wheels, and keys can be constructed of it. It shows a fine-grained fracture something like steel, instead of the coarse zinc-like appearance of aluminium. Its specific gravity is $2.52 \pm 0.03$. The tensile strength of magnalium ranges between 20 and 24 kilos. per square mm.—12.7 to 15.2 tons per square inch—whereas that of aluminium is only 7 kilos. per square mm.—4.5 tons per square inch. This is Kaempfer's figure for ordinary aluminium; we should prefer to quote 7 tons for cast metal, and 10 to 14 for sheet or bars. Magnalium can be easily coated with gold or nickel—? electrolytically—and it can be soldered satisfactorily. The alloy is stated to resist the atmosphere well, not to 'rust,' and to bear exposure to ammonia and sulphurous acid. It has been taken up by Voigtländer und Sohn, the opticians of Brunswick, while Siemens and Halske, of Berlin, are reported to be using it in armatures and motor car construction. At present its cost is high, as the price of magnesium is still 18 marks per kilo.; but hopes are entertained that a larger market for magnalium may reduce the price of that metal considerably."—*Engineer* (London).

## GUNPOWDER AND EXPLOSIVES.

NITRO-CELLULOSE AND SMOKELESS POWDERS.—A review of Lieutenant Bernadou's new work on "Smokeless Powder, Nitro-cellulose, and Theory of the Cellulose Molecuse" is given at the end of this number of the PROCEEDINGS. This book covers ground hitherto vacant in the literature of ordnance chemistry. There is much that is new and original and the remainder of the work is made up of valuable material, brought together for the first time, which would require much reading to discover and much more to put in such acceptable form. Every one interested in ordnance should study it carefully.

NAVY SMOKELESS POWDER.—The Chief of the Bureau of Ordnance, U. S. Navy, says that the manufacture of smokeless powder for the navy is now in a satisfactory state and no further trouble is to be anticipated with the powder now being made, which is much superior to that being turned out a year ago. The precautions and inspections called for by the recent general order are sufficient to insure the safe storage of nitro-cellulose powders, even if not of the very latest and best type. The explosion at Indian Head was probably caused by the decomposition of some powder made when the process of manufacture was just begun there and of much inferior quality to that now produced. The powder which exploded at Mare Island came from private manufacturers, and while the examining board could not positively demonstrate that the explosion was caused by decomposition, the evidence goes far to support that conclusion. Admiral O'Neil says that the Bureau does not doubt the safety of cordite powder, but believes that it deteriorates with age, is very susceptible to changes of temperature, which affects its efficiency, and is very destructive to the bores of guns. Black powder is still used for ignition charges, as all attempts to use fine grain smokeless for that purpose has resulted in a dangerous rise in pressure.

SMOKELESS POWDER FOR THE ARMY.—The Chief of Ordnance, U. S. Army, says: "The question regarding the use of powders with and without nitroglycerin seems to be, all circumstances considered, in favor of powders of a pure nitrocellulose type, when sufficient chamber capacity in the guns is given to permit of their use. In the matter of erosion, experience has not been sufficient to demonstrate the effect of nitro-cellulose powders. It is learned, however, that a 4-inch and 5-inch gun have been fired about 700 times each with this powder, and yet they do not show any appreciable wear or falling off in velocity.

"As to the stability of smokeless powder, the only test is time, and there is nothing to show that the various mixtures of nitroglycerin and gun-cotton are in any way superior to gun-cotton alone."

COMB-SHAPED POWDER OF MM. DU BUIT AND LUCIANI.—MM. Du Buit and Luciani have recently conducted a series of experiments with smokeless powders made up in shape of a comb, and, from the accounts published, this seems a very favorable form of grain. The experimenters say they are able to vary the action of powder within wide limits by changing the shape and size of the teeth, or fringe, and of the back of the comb, or rod to which the fringe is attached. At first glance the form selected does not seem particularly well adapted to the end sought.

The burning surface does not progressively increase as inflammation proceeds and our judgment would be that the pressures would rise too high early and fall too rapidly as the combustion proceeded. Or, if kept within bounds as regards the maximum, the mean and ultimate pressures would be too low; and that an attempt to sustain the pressure would result in much unburned powder. The proof of the pudding, however, is in the eating, and the following results are claimed to have been achieved. The French 47-millimeter (3-pounder) gun, which, using a charge of 550 grams of ordinary powder, gave a velocity of 2840 f. s. with 38,340 pounds pressure, gave the same velocity with 475 grains of the new powder and the pressure was less than 28,400 pounds (2000 kilos. per cm. sq.). In a 3-pounder of 60 calibers' length the velocity with powder of ordinary form is 3018 f. s., and the corresponding pressure 38,340 pounds. The comb powder in this piece gives the same velocity with a pressure of 34,080 pounds. With pressure of 38,340 pounds the velocity was increased to 3372 f.s. In a 2.96-inch field piece, which, with a charge of 625 grams of ordinary powder, gave a velocity of 1640 f. s. with 28,400 pounds pressure, the same weight of new powder gave a velocity of 1771 f. s. and a pressure 25 per cent less. By increasing the charge until the pressure reached 28,400 pounds, the velocity was increased to 1968 f. s. In a 5.9-inch gun of 45 calibers the service charge gives a velocity of 2625 f. s. with a pressure of 36,920 pounds (16.5 tons per square inch), while the new powder gave 3018 f. s. with the same pressure.

These results are remarkable and certainly the means by which they are brought about are worth investigating. As a commentary upon the above, it is interesting to compare the remarks of Mr. Sohlman upon the most desirable shape of powder grain. (See the following note upon the "Development of Smokeless Powder in Sweden.")

THE DEVELOPMENT OF SMOKELESS POWDERS IN SWEDEN.—In a letter to *Engineering*, London, Mr. Ragnar Sohlman, of the Bofors Works, Sweden, says:

"The interesting articles in your esteemed journal on the subject of American experiences in regard to the different kinds of smokeless powders, fully corroborate the similar results arrived at in Sweden.

"In this country nitroglycerin powders have been used by the navy since 1892, and have of late been adapted also for certain heavy guns belonging to the coast defence; whereas the army is using principally a nitrocellulose powder, manufactured at the government factory.

"Up to 1896, smokeless powder was used by the navy only for the light quick-firing guns. That year it was adopted also for the new 12-centimeter (4.7-inch) quick-firing guns.

"The nitroglycerin powder employed for these purposes was ordinary ballistite, containing 50 per cent nitroglycerin and 50 per cent nitrocellulose of about 12 per cent nitrogen. The heating and erosive effect of this powder is very much the same as that produced by cordite. By using a more suitable shape of the grain—*tubes* instead of *cords*—it was, however, possible to attain a satisfactory velocity without too excessive pressure, thus avoiding a too great erosive effect on the bore of these light guns.

"In 1897, during firing experiments carried out at Bofors with a 15-centimeter (5.9-inch) quick-firing gun with very small chamber space,

it was found that the heating effect of the powder was too considerable to make it suitable for a gun of this caliber. After a few rounds, a considerable wasting away of the metal around the seat of the projectile was perceptible. After three rounds, using the same metal cartridge case, this was completely worn out at the edge, and could not be used further.

"It was then found necessary to alter the composition of the powder in order to obtain a lower temperature of combustion and, consequently, less corrosive effect.

"This aim was arrived at by lessening the percentage of nitroglycerin to 25 per cent, and using a 'moderant,' which is at the same time a solvent for nitroglycerin and nitrocellulose. In this way it is easy to obtain a composition giving even a lower development of heat and larger volume of gas per unit of weight than a pure nitrocellulose containing a low percentage of nitrogen, such as, for instance, the German Troisdorf powder.

"To prove this, the following results obtained by calorimetric test of the two powders may be cited:

| Kind of powder. | Heat units per gram. | Volume of gas of combustion. Permanent. | Aqueous. | Total. | Heat volume of gas per gram.* |
|---|---|---|---|---|---|
| Nitroglycerin powder. (Yielding 11.27 per cent N.*) | 922 | 813 | 165 | 978 | 901.7 |
| Troisdorf powder. (Yielding 11.98 per cent N.*) | 943 | 750 | 172 | 922 | 870.5 |

* Nitrogen determined by nitrometer.

"As will be observed, the nitroglycerin powder is capable of performing a slightly greater amount of work per unit of weight, under the same conditions, although the heat produced per gram is somewhat less.

"These theoretical calculations have been upheld by actual experience, the modified nitroglycerin powder having given satisfactory results in various heavy guns, up to such of 25.4 centimeters (10-inch) caliber.

"The experience in Norway, where a similar nitroglycerin powder is used by the army as well as by the navy, for guns of all calibers, and also for the army rifle, seems to be very much the same as in Sweden. Since 1893, when the powder was first introduced into the service, no serious complaints have been made against it.

"In taking cordite as the representative type of powders containing nitroglycerin, as has been done by the author of a paper which appeared on March 8 in your journal, and condemning the whole class on account of the demerits of cordite, a great injustice is certainly done towards the more modern types, which do not share the same faults. For it can hardly be denied that cordite is in several respects an antiquated powder, however great may have been its merits at the time of its first appearance, and even then these merits were disputed.

"Thus, the *cord* shape is not by far comparable to the *tube* or *multiperforated grain*, when a high ballistic effect with moderate pressure is desired.

"Further, the use of insoluble nitrocellulose, together with a moderant—vaseline—which is not a solvent, either for nitroglycerin or for nitrocellulose, causes serious disadvantages, which are still further aggravated by the excessive percentage of nitroglycerin contained in the powder. By exposing cordite to heat and pressure, it is easy to cause the nitroglycerin to separate from the nitrocellulose in a way very similar

to the squeezing out of water from a wet sponge. It is all but possible that the same phenomena occur, at least partly, in the combustion of cordite in a gun. If this be so, the nitroglycerin will burn slightly quicker than the nitrocellulose and vaseline, producing a higher temperature in the beginning of combustion of the charge than the composition of the powder and the colorimetric data would indicate.

"A further disadvantage of cordite, which does not exist with the low percentage nitroglycerin powders containing soluble nitrocellulose, is the exudation of nitroglycerin, which takes place at a low temperature.

"The main advantage of the nitroglycerin powders are, in the view of your correspondent, their absolute freedom from porosity. A nitrocellulose powder, containing a few per cent of volatile solvent, is apt to lose part of this during prolonged storage. The evaporation of the solvent will cause a tendency of the interior of the grains to contract. As the surface is hard and brittle, the grains will be exposed to internal stresses which may, under unfavorable conditions, cause their breaking up in the bore of the gun, thus producing an excessive pressure.

"In the evaporation of the solvent, a certain porosity is unavoidable. This porosity causes a certain hygroscopicity of the pure nitrocellulose up in the bore of the gun, thus producing an excessive pressure.

"The advantages claimed for the pure nitrocellulose powders are a high degree of chemical stability and low temperature of combustion. As it seems, however, quite feasible to arrive at the same results, and gain other very important advantages, with a nitroglycerin powder containing a low percentage of nitroglycerin, such powders will probably, as is also pointed out by Mr. Willcox, prove the most satisfactory for the future."

Mr. Sohlman's first paragraph refers to a long article by Mr. F. A. Willcox, B. Sc., which was published in *Engineering*. Taking as a guide rather old experiments made by our army ordnance officers, Mr. Willcox reaches the conclusion that the best smokeless powder is likely to be one in which there is a moderate amount of nitroglycerin (say not over 25 per cent) combined with gun-cotton. That our army ordnance officers have not arrived at the same conclusion is apparent from the report of the Chief of Ordnance. (See note "Smokeless Powder for the Army," on a preceding page.)

CHLORATE MIXTURES: KEEPING QUALITIES.—The keeping qualities of mixtures in which one of the chlorates is a principal ingredient have not been considered satisfactory. Perfectly safe when freshly made—more so than many explosives of better general reputation—they usually deteriorate through time and even moderate irregularities of temperature until they explode spontaneously or with the very slightest shock. In the annual report of H. B. M. Inspectors of Explosives for 1900, published during the past summer, we find that several chlorate compositions have passed the storage stability tests and are now licensed for use and carriage in Great Britain.

BORLAND SYSTEM FOR THE MANUFACTURE OF NITRO EXPLOSIVES.—Mr. W. D. Borland has recently taken out (in England; date of patent January 19, 1901) a patent for the manufacture of nitro explosives. In the specification the patentee describes, first, a method of regulating the hardness, density, and explosive qualities of nitro compounds, whether

in the form of powder or otherwise, and second, a method of removing the solvent which usually clings to a small but injurious extent in the manufactured nitro explosives.

"It has been usual in the manufacture of granular and other nitro-compound explosives to treat them with solutions of materials having a solvent or other regulating action. The above patentee finds that it is possible greatly to enlarge the scope of such treatments by employing emulsions instead of solutions. These emulsions consist of methylated spirits and small quantities of some such material as acetone, camphor, liquid paraffin and benzoline, or refined naptha. The liquid paraffin is very slightly soluble in all these materials, except benzoline, but it forms with them a good emulsion, and may in the emulsion be introduced into the nitrocellulose compound without having, as is usual, first to subject the compound to the action of solvents, and then to the process of introducing the oily matter.

"The effect, upon the ballistic qualities of the powder, of introducing the oily material in the form of emulsion, is very different to that resulting from its introduction in solution. By this emulsion method a very hard grain may be obtained, which at the same time is porous. The proportion of the following example of an emulsion used per ton of powder would be about 120 gallons:

1000 parts by volume of methylated spirits.
10 parts by volume of acetone.
5 parts by weight of camphor.
5 parts by weight of liquid paraffin.
30 parts by volume of benzoline or refined naptha, specific gravity .700 to .776.

"The above emulsion is suitable for treating a granular nitro-compound, consisting mainly or wholly nitrocellulose.

"As regards the removal of the small quantities of volatile solvents, which are retained in the nitrocellulose explosive, the presence of such a non-volatile body as liquid paraffin would rather increase the liability to retention of the remaining volatile portions; but the patentee overcomes this difficulty, both as regards compounds treated with this emulsion, and with solution, by treating the nitro-compounds with warm air. The temperature of the air should be about 150 degs. Fahr., and should be charged with watery vapor. One method of so charging the air is to admit a small jet of low pressure steam into the inlet opening of a fan for supplying the warm air. Air so charged speedily removes the remaining volatile constituent parts, and a further benefit is reaped inasmuch as the generation of electricity, which is frequently observed in dealing with hot dry nitrocellulose explosives, is practically obviated."—*Arms & Explosives.*

## GUNS.

UNITED STATES NAVAL GUNS: EXTRACTS FROM REPORT OF CHIEF OF BUREAU OF ORDNANCE.—The following extracts from a *résumé* of the report of the Chief of Bureau of Ordnance are derived from the *Army and Navy Journal* of October 26. The complete report has not yet (November 10) been published.

"There were no important developments in armor or naval ordnance

during the year, but improvements were made in details. Hereafter in constructing guns of and above 6 inches caliber provision will be made for an inner and outer barrel, instead of a solid forging as heretofore. The bureau has taken steps to procure greater efficiency in guns by introducing heavier projectiles and by seeking powder of higher ballistic power. The bureau knows of no guns afloat or soon likely to be put afloat equal in energy to those being manufactured for United States' vessels now building. Our equipment is fully up to the highest standard maintained abroad for vessels of corresponding class and age.

"Work at the naval gun factory has been carried on continuously, the principal machines being kept running two, and often three, shifts of eight hours in twenty-four.

"The number of guns completed during the year was 143, and 256 were partly completed. There were also on hand at the end of the year, forgings, on which no work had been performed, for a large number of guns of all the calibers.

"The 6-pounder automatic guns do not meet with universal favor in the service. The automatic feature need not be used, however, unless desired."

UNITED STATES SEACOAST ARTILLERY: NEW 16-INCH GUN.—The principal details are as follows: Charge, 576 pounds of the present army smokeless powder; or 1176 pounds brown powder; chamber pressure, 37,000 to 38,000 pounds; projectile, 2370 pounds; muzzle velocity, 2300 f. s.; muzzle energy, 88,000 f. t.; length of gun, 49.25 feet; diameter of breech, 5.0 feet; diameter of muzzle, 2.33 feet; caliber, 16 inches; weight, about 300,000 pounds; shrinking between tube and jacket, .06 inch; weight of tube, 102,000 pounds; weight of jacket, 76,000; at 40° elevation, the estimated range is 20.98 miles; maximum elevation of point of trajectory, 30,516 feet.

GUNS FOR SPANISH NAVY.—It is reported that the Spanish Minister of Marine has ordered from Messrs. Vickers, Sons & Maxim a number of 177-millimeter (6.97-inch) rapid-firing guns. The weight of projectile is stated at 96 kilograms (211.6 pounds—which is excessive for this caliber), and that the required speed is eight shots per minute. It is quite likely that the gun is the 7.5-inch.

BRITISH 12-INCH, 40-CALIBER WIREWOUND GUN (VICKERS-MAXIM).—This gun, built by Messrs. Vickers, Sons & Maxim, is intended for the new battleships. Its section is shown in Fig. 1. The dotted lines above the gun show the pressure curves with nitrocellulose powder and with cordite. The longitudinal shading in this as in the other figures shows the wire. The total length of the gun is 496.5 inches; length of powder chamber, 87.2 inches; diameter of powder chamber, 17.5 inches; length of bore, 480 inches; travel of shot, 33 feet; maximum pressure in gun, 17 tons; weight of projectile, 850 pounds; cordite charge, 207 pounds; corresponding velocity, 2500 f. s. when gun is new; nitrocellulose charge, 321 pounds; corresponding velocity, 2674 f. s. for a very large number of rounds, the loss from erosion with nitrocellulose powder being very slight compared with that from erosion caused by cordite; energy corresponding to a velocity of 2500 f. s., 36,837 foot tons; energy corresponding to 2674 f. s., 42,144 f. t.; weight of gun, 50.35 tons.

Fig. 1.

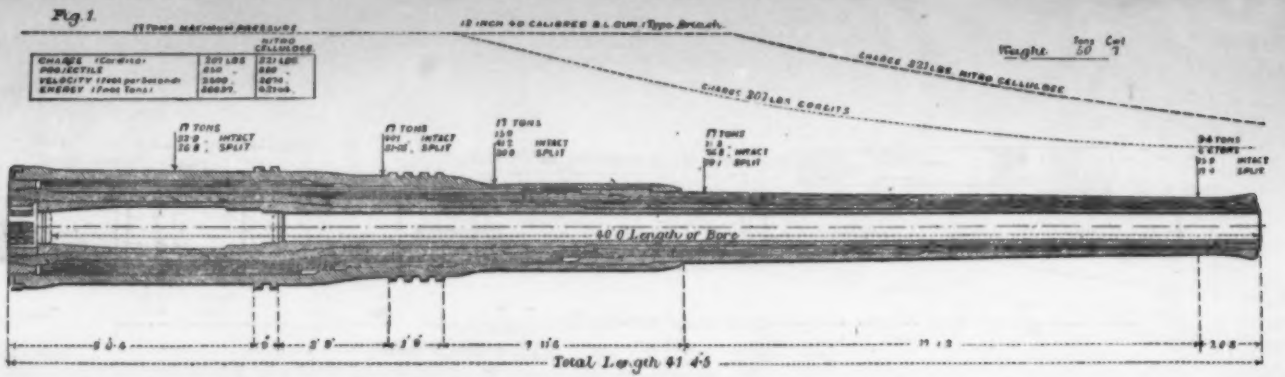
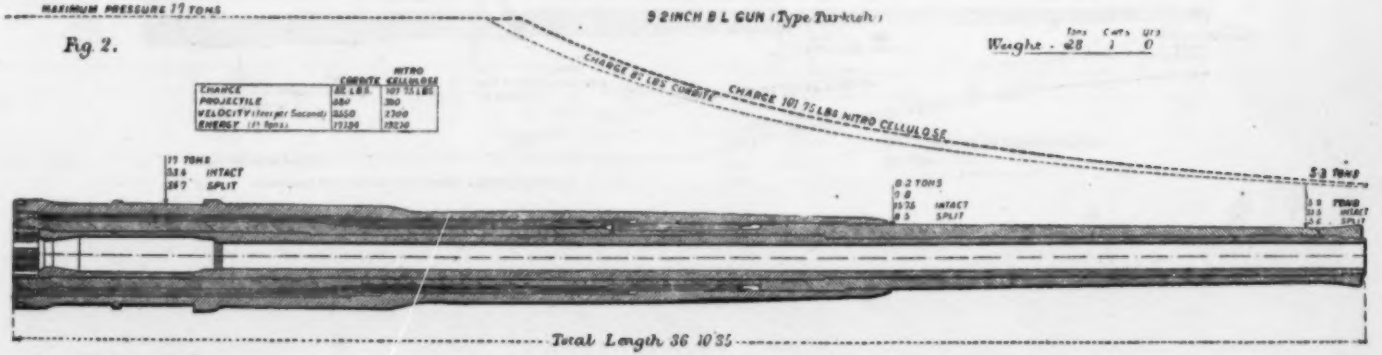
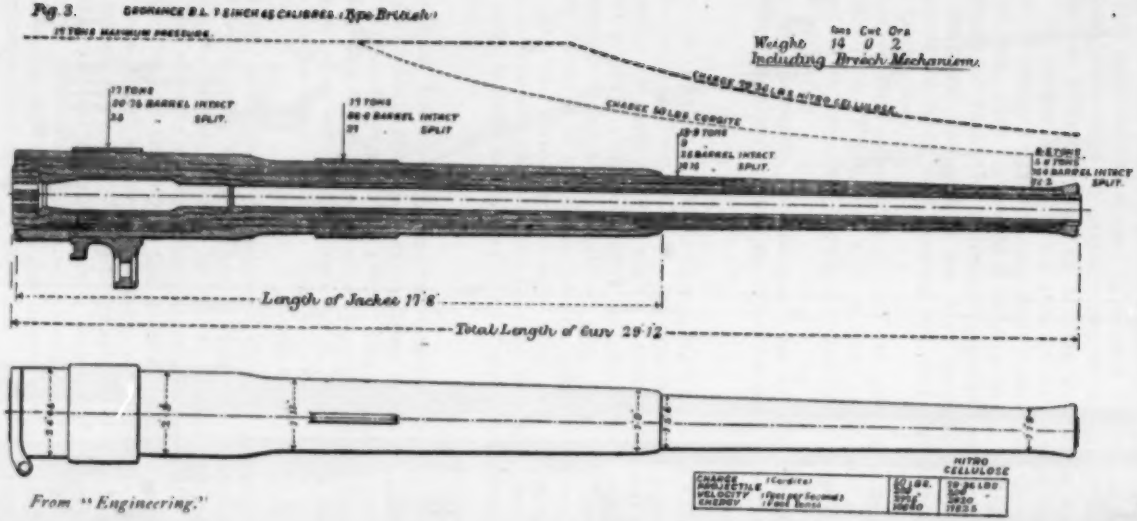

13 TONS MAXIMUM PRESSURE
12 INCH 40 CALIBRES B.L. GUN (Type Brown)
Weight 50 7
CHARGE 221 LBS. NITRO CELLULOSE
CHARGE 307 LBS. CORDITE
CHARGE (Cordite) 307 LBS 221 LBS.
PROJECTILE 850 " 850 "
VELOCITY (Feet per Second) 2400 " 2470 "
ENERGY (Foot Tons) 20639 " 21748 "
NITRO CELLULOSE
13 TONS 33·8" INTACT 35·8" SPLIT
13 TONS 10·1" INTACT 10·2" SPLIT
13 TONS 13·0 11·2 INTACT 10·0 SPLIT
13 TONS 11·8 10·8" INTACT 10·1" SPLIT
9·6 TONS 13·0 INTACT 11·4 SPLIT
40·0 Length of Bore
8'0·4
0'0
2'0"
1'6"
9'11"
Total Length 41 4·5

Fig. 2.


MAXIMUM PRESSURE 17 TONS
9·2 INCH B.L. GUN (Type Turkish)
Weight 28 1 0
CHARGE 87 LBS CORDITE
CHARGE 101·75 LBS NITRO CELLULOSE
NITRO CORDITE CELLULOSE
CHARGE 87 LBS. 101·75 LBS.
PROJECTILE 380 " 380 "
VELOCITY (Feet per Second) 2050 " 2300 "
ENERGY (Ft Tons) 12206 " 15230 "
17 TONS 33·6 INTACT 28·7 SPLIT
8·2 TONS 11·8 10·76 INTACT 10·5 SPLIT
5·3 TONS
Total Length 36 10·35

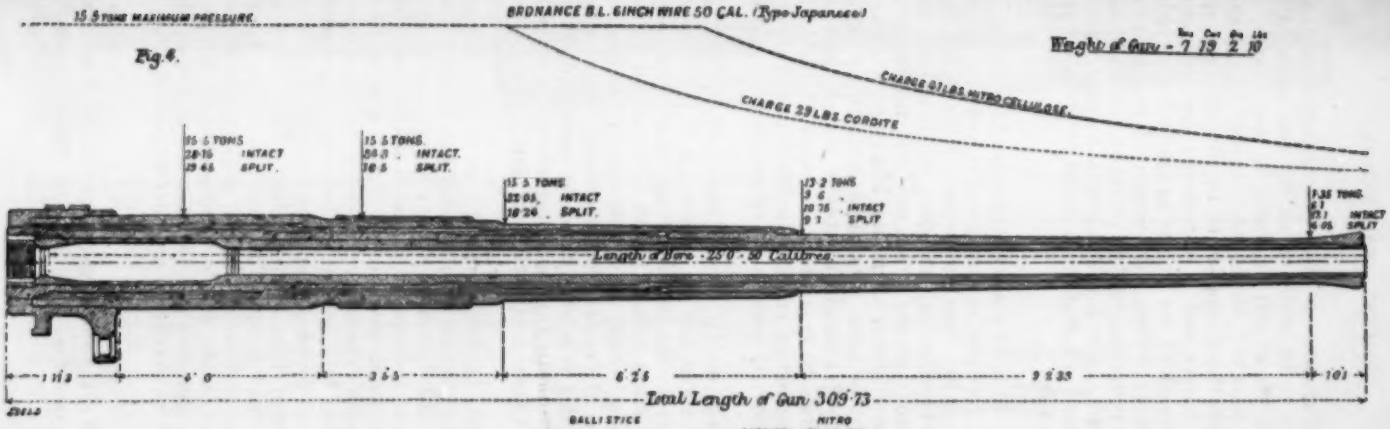
*From "Engineering."*

*Fig. 3.* ORDNANCE B.L. 9 INCH 45 CALIBRES. (Type British)




*From "Engineering."*

Fig. 4.




| BALLISTICS | CORDITE | NITRO CELLULOSE |
|---|---|---|
| WEIGHT OF PROJECTILE | 100 LBS | 100 LBS |
| WEIGHT OF CHARGE | 29 " | 61 |
| MUZZLE VELOCITY (ft Secs) | 2000 | 2000 |
| MUZZLE ENERGY (ft Tons) | 6240 | 6240 |

From "Engineering."

TURKISH 9.2-INCH, 47-CALIBER GUN (VICKERS-MAXIM).—Guns of this type (see Fig. 2) are to be mounted on the reconstructed Mesudieh, a description of which vessel will be found in this number of the PROCEEDINGS under the head of "Ships, etc.,—Turkey," page 776. The type differs somewhat from those supplied to the British naval service. It is about two calibers longer and is wirewound for only about half the length. The total length of the gun is 442.35 inches; length of bore in calibers, 46.7; length in inches, 430; weight of projectile, 380 pounds; weight of charge, 82 pounds of cordite, or 101.75 pounds of nitrocellulose; corresponding velocities, 2550 f. s. and 2700 f. s.; coresponding energies, 17,134 f. t. and 19,210 f. t.; maximum chamber pressure, 17 tons; total weight of gun, 28.05 tons.

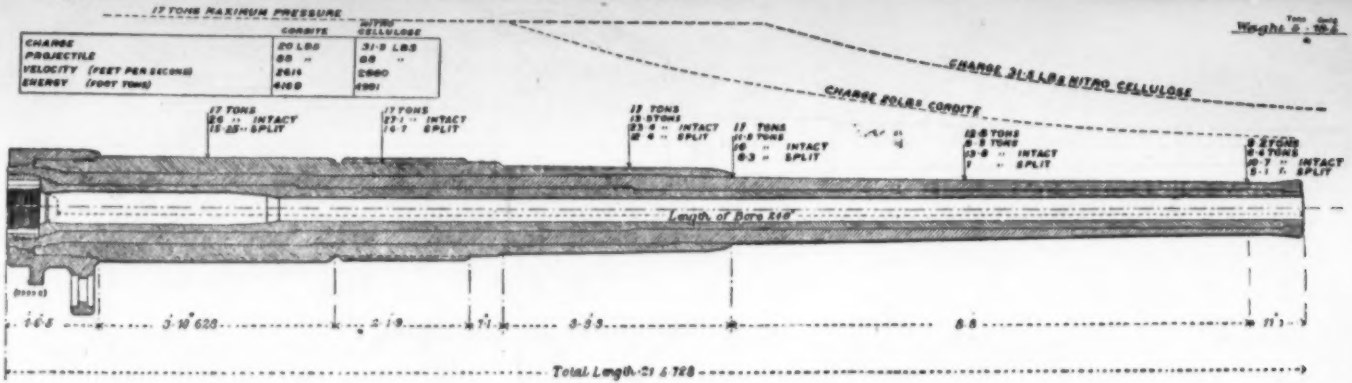
BRITISH 7.5-INCH GUN (VICKERS-MAXIM).—As may be seen by an inspection of Fig. 3, this gun is wirewound throughout its length. This is not the gun which has been so frequently illustrated and described (e. g. *Scientific American*, January 12, 1901), but is shorter, being only 45 calibers in length, and it weighs 2 tons less than the 50-caliber piece. It is intended for the new British battleships and cruisers. The total length is 349.2 inches; length of bore, 337.5 inches (exactly 45 calibers); weight of projectile, 200 pounds; weight of cordite charge, 50 pounds; weight of nitrocellulose charge, 79.36 pounds; corresponding velocities, 2775 f. s. and 2920 f. s.; corresponding energies, 10,680 f. t. and 11,825 f. t.; maximum chamber pressure, 17 tons, total weight of gun, 1403 tons.

JAPANESE 50-CALIBER 6-INCH GUN (VICKERS-MAXIM).—This gun (Fig. 4) is wirewound for about half the length. It is the new type Japanese gun, and is from five to ten calibers longer than those now in service. The total length is 309.73 inches; length of bore, 300 inches; weight of projectile, 100 pounds; weight of cordite charge, 29 pounds; weight of nitrocellulose charge, 47 pounds; corresponding velocities for both powders, 3000 f. s. (but this velocity will not be preserved if cordite is used on account of the erosion); corresponding energy, 6240 tons; maximum pressure in gun, 15.5 tons; total weight of gun, 7.98 tons.

SPANISH 45-CALIBER, 14-CENTIMETER (5.5-INCH) GUN (VICKERS-MAXIM).—This (see Fig. 5) is the new type Spanish gun which will be placed on some of the vessels now building. Unlike the guns already described, it is not wirewound and is therefore probably a stiffer and more accurate piece. It is like the latest model of our 6-inch guns in having an inner and outer tube extending the full length and in having a very long jacket. Both jacket and outer tube are put on from the muzzle with a taper of 1 in 500 with the usual shrinkage; and the breechplug is housed in a ring screwed into the outer tube from the rear. The breech is further reinforced by an external hoop. The total length of the gun is 257.73 inches; length of bore, 248 inches; weight of projectile, 88 pounds; weight of cordite charge, 20 pounds; weight of nitrocellulose charge, 31.5 pounds; corresponding velocities, 2614 f. s. and 2880 f. s.; corresponding energies, 4169 f. t. and 4991 f. t.; maximum pressure in gun, 17 tons; total weight of gun, 5.925 tons.

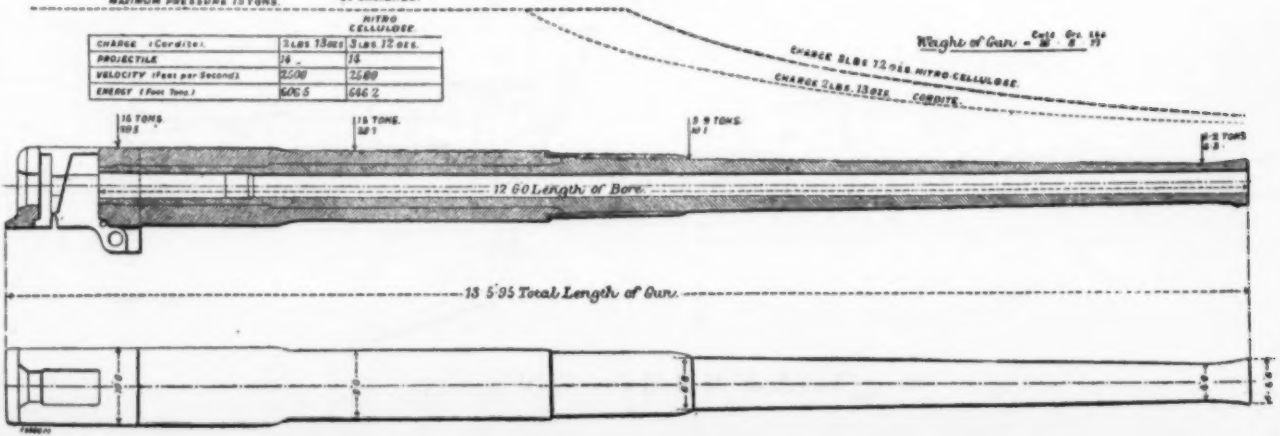
UNITED STATES NAVY 3-INCH, 50-CALIBER, SEMI-AUTOMATIC GUN AND MOUNT.—This gun (see Figs. 6, 9, and 10) differs from our rapid-fire

Fig. 5. 14in 40 CALIBRES B.L.R. GUN (Type Spanish).




| | CORDITE | NITRO CELLULOSE |
|---|---|---|
| CHARGE | 20 LBS | 31·5 LBS |
| PROJECTILE | 80 " | 80 " |
| VELOCITY (FEET PER SECOND) | 2614 | 2960 |
| ENERGY (FOOT TONS) | 4169 | 4991 |

Fig. 6. 3 INCH (14 pdr) AUTOMATIC Q.F. GUN (Type United States of America).
MAXIMUM PRESSURE 15 TONS. 50 CALIBRES.




| | 3 LBS 13 OZS. | 3 LBS. 12 OZS. |
|---|---|---|
| CHARGE (Cordite) | | NITRO CELLULOSE |
| PROJECTILE | 16 | 16 |
| VELOCITY (Feet per Second) | 2208 | 2589 |
| ENERGY (Foot Tons) | 606·5 | 666·2 |

From "Engineering."

*Fig. 9a*

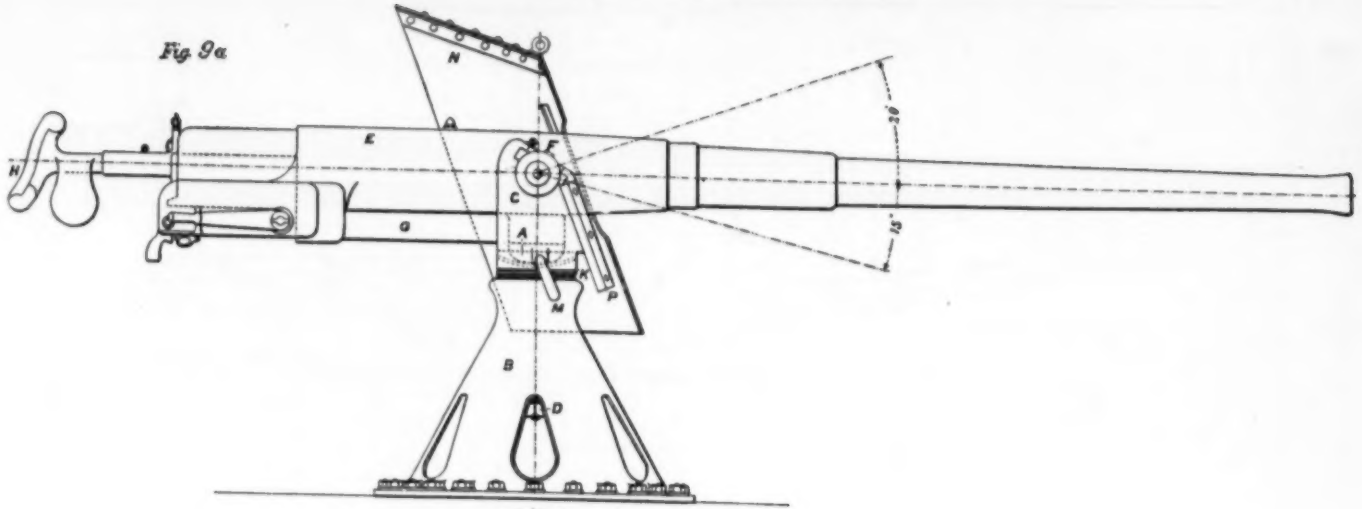
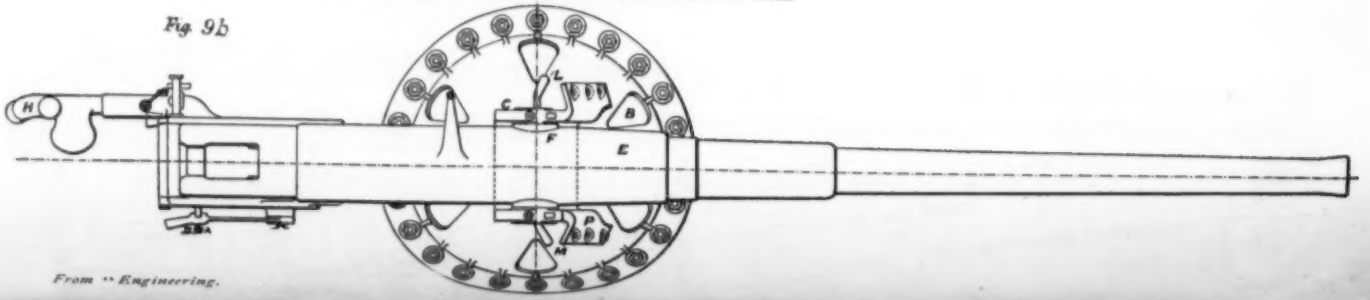



*Fig. 9b*




From "Engineering."

From "Engineering."

Fig. 10

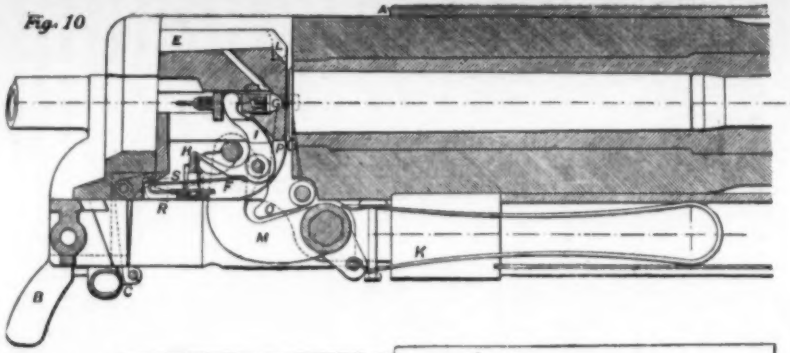



Fig. 10

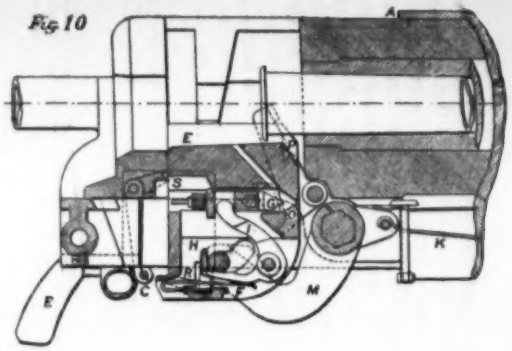
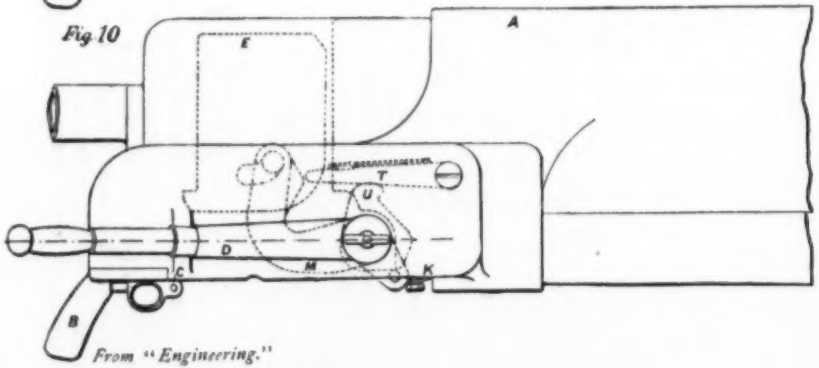



Fig. 10




From "Engineering."

3-inch in having a Hotchkiss block instead of the Welin plug and modified Fletcher mechanism. The mechanism is similar to that of the 6-pounder semi-automatic gun now in service. The particulars of the gun proper are very similar to those of the 3-inch R. F. G. given in the table in PROCEEDINGS No. 99, page 555, but even where identical they are given here for convenience. Total length, 161.95 inches length of bore, 150 inches; weight of charge (navy smokeless, nitrocellulose), 5 pounds; weight of projectile, 13 pounds; corresponding velocity, 2800 f. s.; corresponding energy, 709 f. t.; weight of gun, 0.9 ton.

The mounting (Fig. 9) consists of a top carriage A, which works in a steel cone-shaped pivot stand B, and has its upper part formed into a crosshead C. The cone is provided with gun-metal liners, and the pivot is secured to it by means of a pivot nut D. The cylindrical sleeve E, in which the gun is free to slide in recoiling, is supported by trunnions F in bearings formed in the arms of the top carriage; and it is provided with two hydraulic cylinders G, in which work pistons attached to a lug on the under side of the breech end of the gun. The elevating and training are effected by means of a shoulder piece, H, attached to the sleeve. The top carriage is fitted with a clamping screw and a traversing clamping segment which fits into a groove, K, in the liner. When tightened by means of the handle, L, this segment secures the gun in any required position of train. A similar handle at M clamps the gun at the desired degree of elevation.

Protection is afforded the gunner by a shield, N, which is bolted to flanges, P, forged on the arms of the top carriage. The hydraulic cylinders are provided with tapered grooves, which allow the liquid to escape around the pistonheads, and so regulate the flow that a constant pressure is maintained during recoil. Inside the cylinders are strong spiral springs surrounding the piston rods which, being compressed by the rearward motion of the pistonheads, return the gun to battery after the recoil is checked.

The breech mechanism and semi-automatic gear are shown in Fig. 10. Under the rear end of the sleeve, A, is the pistol grip, B, which contains the trigger, C, and on the right side is a detachable lever, D, by the movement of which the breech block, E, can be raised or lowered. The breech block is capable of vertical movement and contains the main-spring, F, the firing pin, G, the sear, H, and the cocking lever, I. Between the hydraulic cylinders there is a powerful flat spring, K, which works the breech mechanism.

To prepare the gun for firing, the breech is opened by the movement of the hand lever, D, the handle of which is supported in a shallow crutch formed on the side of the sleeve. This lever turns the crank, M, the action of which brings down the breech block, E, and compresses the flat spring, K. At the same time the main-spring, F, is compressed and kept compressed by the sear, H. The breech block, in moving down, strikes the lower extension, O, of the extractor and causes the upper portion to move out from the face of the barrel and bring two small projections, P, over the upper edge, L, of the breech block, E, thus preventing it from rising from the pressure of the spring, K. The cartridge is pushed smartly into the bore and, as it goes forward into the chamber, its rim strikes against the extractor and forces back the projections, P, releasing the breech block which now rises, pressed up by the spring, K, which rotates the crank, M. The tail end, R, of the sear

is now engaged with the toe, S, of the trigger, and by pulling the trigger, C, the sear is released and the firing pin, G, is thrown forward by the main-spring, F. This fires the cartridge and the gun recoils in its sleeve. The recoil, which is controlled by the hydraulic cylinders, compresses the counter-recoil springs, which return the gun to battery. As the gun returns, the action pawl, T, engages the hook, U, on the crank, M, and causes the crank to turn about its axis and thereby bring down the breech block. The extractor throws out the empty shell, first loosening it by a slow movement which increases rapidly enough to give it the necessary impetus to clear the breech. The action then proceeds as before.

VICKERS-MAXIM BREECH MECHANISM FOR 6-INCH GUN.—The breech mechanism shown in Figures 7a, 7b, 7c, 8a, and 8b is the new Vickers-Maxim design for 6-inch guns, and is used in our service on the 5-inch, 6-inch, 7-inch, and 8-inch quick-fire guns. The breech-plug is divided into six segments, four of which are threaded, so that two-thirds of the circumference is used to resist the powder pressure.

The link for actuating the breech-plug is pivoted to a pin, G, projecting from the breech-plug, B, at one end, and pivoted at the other end to a short crank, H, which is mounted on the carrier, D. Partly around the boss of this crank, H, are formed "skew gear" teeth, which gear with "skew" teeth formed around a sleeve keyed to the hand lever. A loading tray, I, is provided, which is automatically moved across the breech face of the gun, and at the same time raised into the loading position while opening the breech (or lowered when closing it).

The firing gear is arranged for firing by electricity or percussion, and is directly operated by the hand lever, A, so that the gun is absolutely safe against firing after the breech commences to open. For this purpose a nut, K, is fitted on the end of the mushroom stem, L. In this nut a vertical slide, M, which covers the end of the primer, N, is worked by means of two spring bolts. One of these bolts, O, engages with a cam, P, on the hand lever, A, the other, Q, in a groove, R, in the link of the breech mechanism. An ejector, S, actuated by the movement of the slide, is fitted in the nut. A spring-retaining catch is fitted in the end of the mushroom stem and prevents the primer from being jerked out, however violently the mechanism may be closed.

The motion is as follows: When the hand lever, A, of the breech mechanism, is swung away from the gun, the cam, P, forces the slide, M, downwards in the nut, K. As the hand lever, A, continues to swing away from the gun, it eventually loses its connection with the spring bolt, O, of the slide, M, and the downward movement of this slide is continued by the movement of the link, F, which actuates the other spring bolt, Q, and keeps the slide, M, in the correct relative position until the breech is closed. When the slide, M, has been moved down far enough, it actuates the ejector, S, thus jerking out the primer. On the first movement of the slide, M, downwards, and before the breech has commenced to unlock, the firing pin, C, is partly drawn back by means of the toe, with which it is provided, engaging with a quick incline on the rear of the firing gear nut. The spring bolts are arranged so that in the case of misfire the slide, M, may be pulled down by hand far enough to eject the primer and insert a new one, so that it is unnecessary to open the breech.

Fig. 7a.

BREECH MECHANISM FOR 6 INCH, 50 CALIBRES, Q.F. GUN SCALE $\frac{1}{4}$ths

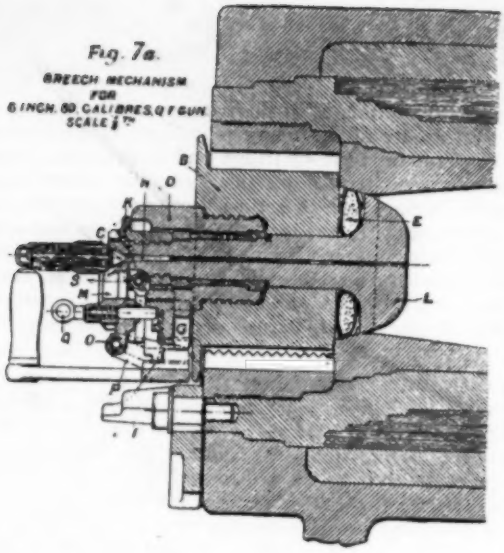



Fig 7b.

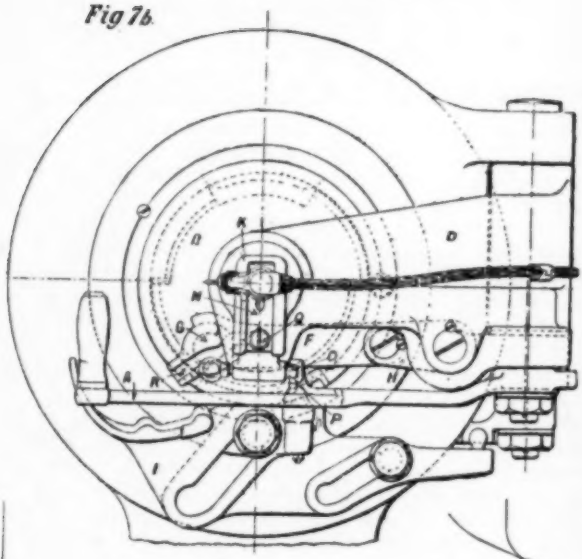
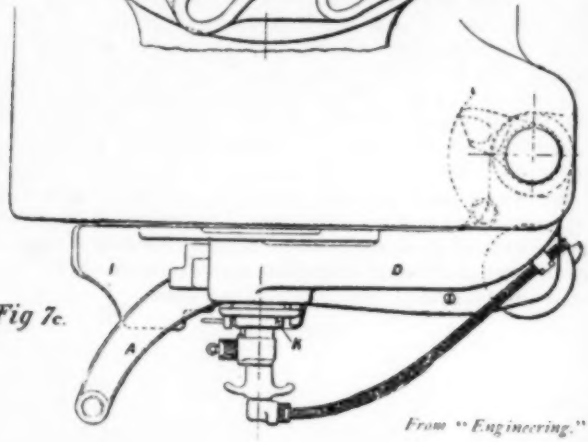



Fig 7c.




From "Engineering."

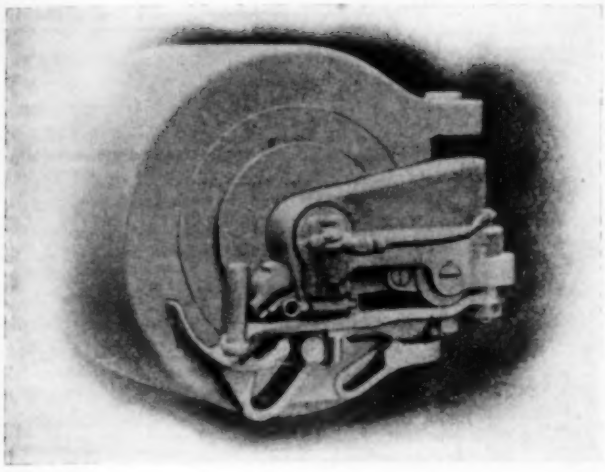


FIG. 8a.

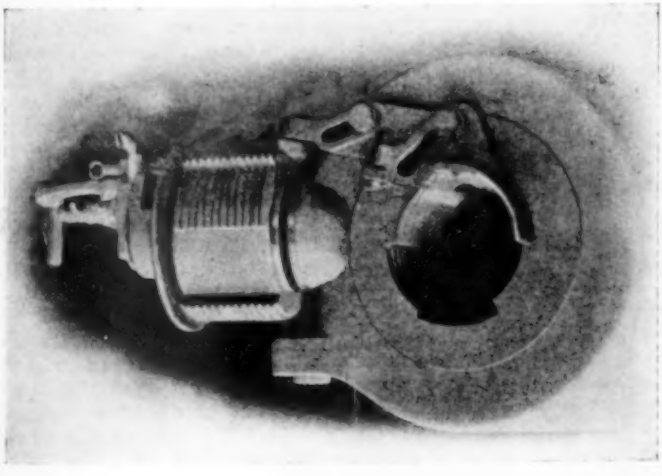
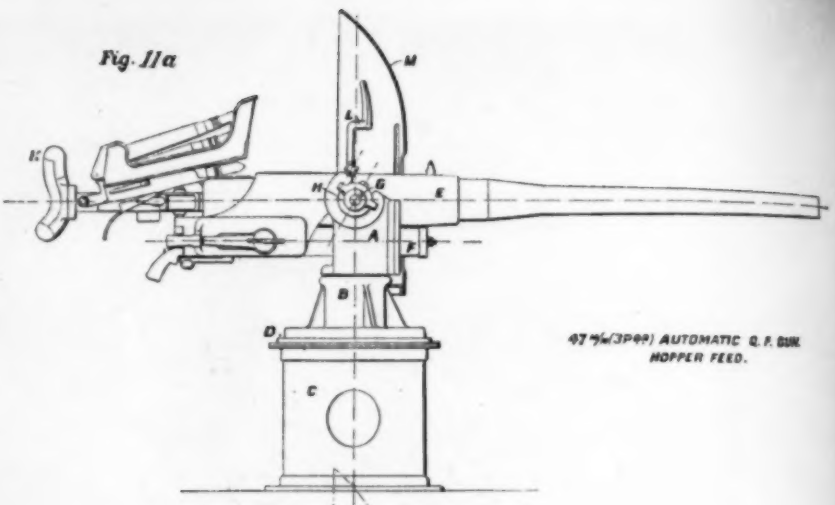


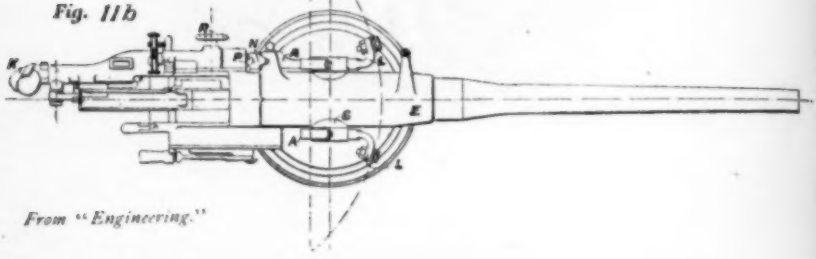
FIG. 8b.

*Fig. 11a*



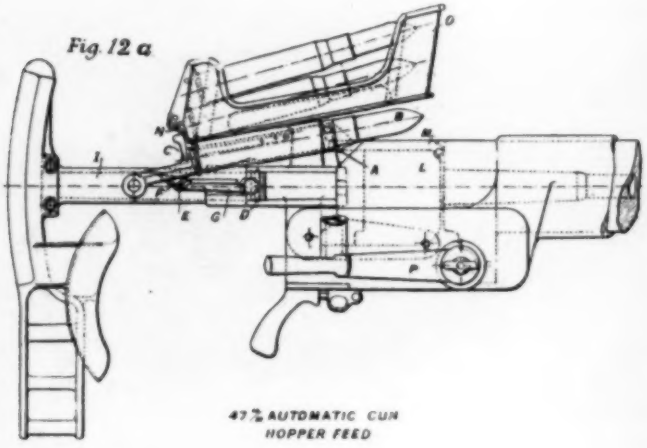

47 ⅞(3P99) AUTOMATIC G. F. GUN.
HOPPER FEED.

*Fig. 11b*



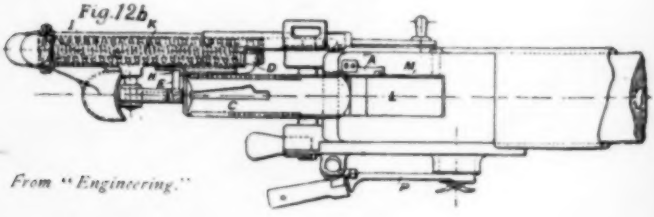

*From "Engineering."*

*Fig. 12a*




47 ⅞ AUTOMATIC GUN
HOPPER FEED

*Fig. 12b*




*From "Engineering."*

THREE-POUNDER AUTOMATIC GUN.—This gun (Figs. 11 and 12) is now under trial for use in the United States Navy. It is made by the Vickers-Maxim Company, and has some features which make it superior to the semi-automatic type. It loads its own cartridge, so there is no danger of burring the face of the breech in loading, or deforming the cartridge by striking the shell, or failing to give the cartridge sufficient force to trip the extractor lugs which hold the breech block down. The automatic feature insures against accident resulting from opening the breech too soon after a hang-fire. This is a very real and serious danger with smokeless powder and must not be lost sight of. The gun and mount are shown in Figs. 11 and 12.

The mount consists of the usual top carriage, A, resting on a circular pivot stand, C, the stalk of the top carriage passing through the socket, B, being secured by a nut underneath. The socket, B, is secured to the lower part of the pivot stand by the holding-down ring, D. The sleeve, E, through which the gun recoils, is provided with a hydraulic cylinder in which works a piston attached to a lug on the gun. On the sleeve are forged the trunnions, G, which are supported in the trunnion seats, H, in the arms of the top carriage.

The elevating and training of the gun are effected by means of the shoulder-piece, K, which is attached to the sleeve. Attached to the top carriage is the elevating segment, N, grooved to receive the front end of the clamping bar, P, which is attached to the sleeve. This bar being tightened in the groove by means of the wheel, R, the gun is fixed at the required elevation. A training clamp is provided by a screw bolt which passes through the socket, B; the outer end is bent at right angles to form a lever. The shield, M, is bolted to the arms, LL, which are cast in one with the top carriage.

The hydraulic cylinder has grooves in its inner surface which allow the liquid to escape around the pistonhead and which so regulate the flow that a constant pressure is maintained during recoil. Inside the cylinder there is a strong spiral spring surrounding the pistonrod, which, being compressed during recoil, returns the gun to battery.

The hopper-feed mechanism is shown in Fig. 12. Its operation is as follows:

When the gun recoils it brings the carrier rest, A, under the lug, B, on the carrier, C, and does not leave it until the gun has returned to its firing position; the carrier, C, can therefore under no circumstances descend until the gun has returned to battery. During the recoil the face of the breech of the gun forces the plunger, D, with its pawl and feeder, E, back until the hook, F, on the pawl, G, passes the lug, H, on the shoulder-piece, I. The pawl is raised by its spring, K, and the hook, F, engages with the lug, H, thereby cocking the plunger piston, D. The gun returns, and at a certain distance before reaching battery, the action pawl, coming into play, opens the breech, and the ejection of the empty case begins.

When fully back to battery, the carrier, C, descends, being clear of the carrier support, A, and after being moved a certain distance it engages with the part of the pawl forming the feeder, E, depressing it, and finally disengaging the hook, F, from the lug, H, on the shoulder-piece, I.

The plunger piston spring, K, reacts and returns the plunger, D, with its pawl and feeder, E, to its original position, the feeder forcing the cartridge in the carrier forward, shooting it into the chamber.

The breech block, L, now rises and, during its ascent, raises the lifting lever, M, and through it the carrier, C. When this latter is nearly home, it engages through the projection with the tail, N, of the escapement, and moves it out of the path of the cartridge in the hopper, O. The cartridge, being thus liberated, slides through the hopper into the carrier, its place in the hopper being taken by the next cartridge, which in turn is locked by the escapement as the carrier descends, and is liberated on the return of the carrier.

When the breech is closed the gun is ready for firing, which is effected by pulling the trigger. By holding the trigger back the gun continues to load and fire without stopping.

NOTE.—The descriptions and plates of the guns described in the foregoing notes (beginning with that of the British 12-inch piece) are derived from an article on the "Development of Ordnance," by Lieut. A. T. Dawson (late R. N. and now a distinguished ordnance engineer), read before the British Institution of Mechanical Engineers, and published in *Engineering* (London). To this most excellent periodical the compiler of these notes is under constant obligation for information concerning every branch of the naval profession.

KRUPP AUTOMATIC BREECH MECHANISM FOR LARGE GUNS.—The operation of the breech is effected by a gear wheel which engages in a rack moving with the gun, but not so rapidly. The gear wheel turns a conveyer screw, operates the breech mechanism and opens the breech. Apparently, from the description given, the breech is started open during recoil, and not during the return of the gun to battery. The British patent bears date of June 29, 1901.

POZZUOLI-ARMSTRONG GUNS.—Fifteen or twenty years ago Messrs. Armstrong, Mitchell & Company (now Sir W. G. Armstrong, Whitworth & Company), established a factory at Pozzuoli, near Naples, Italy, for the manufacture of guns and ordnance material under their patents and designs, and the present Elswick Company still has an interest in the works, if it does not own them. There have been numerous rumors that many guns made at the Pozzuoli factory have proved seriously defective, and the Kriegstechnische Zeitschrift (No. III, 1901) contains an article upon the subject. In this article it is stated that in December last the question was brought up in the Italian parliament, where the charge was made that certain guns furnished to the Italian government by the Pozzuoli factory were so weak that they would not stand a single full charge. The Minister of Marine admitted that the guns referred to were defective, but stated that the defects were to be made good by the Armstrong Company. It was impossible to learn if the charges were based upon very recent work, but in the parliamentary (Italian) discussions of the past eight years it appears that there has been repeatedly manifested a distrust of the material turned out by the Pozzuoli factory. The list of failures is a very long one. Those mentioned in the article are: a 100-ton gun for the Doria, found defective; two 10-inch guns for the Cristobal Colon, rejected on account of defects; the guns of the San Martin had to be constructed in England, notwithstanding this entailed much delay, owing to strikes at Elswick; one 10-inch gun for the José Garibaldi failed; sixty-eight new guns for new Italian ships were rejected as unfit for service after trials, and had to be repaired or replaced.

The failures seem to be due partly to poor material, but chiefly to poor workmanship.

AMERICAN MACHINERY FOR TURKISH ARSENALS.—It is reported from Constantinople that there is every reason to believe that an American syndicate is likely to secure the contract for the renewal of machinery in the Turkish arsenals. At the present time the existing plant, on which many hundreds of thousands of pounds have been spent, is practically valueless, having been allowed to rust and generally to fall into incurable disrepair. It is, in fact, scarcely worth its price as scrap-iron, with the added cost of removing it. Assuming that the American syndicate does actually receive a substantial order, its members will most probably be the sole beneficiaries. Knowing what we do of the Ottoman character, the assertion may with perfect safety be made that the efficiency of the Turkish arsenals will not be increased by any change of plant alone. What is first required is an alteration in the machinery of the Government.—*Arms & Explosives*, July, 1901.

PERSIAN ORDNANCE FACTORY.—The Russian press says that the quality of the work turned out at the gun factory at Teheran, Persia, under the superintendence of German officers, exceeds all expectations. Excellent reports have been given of twenty-three guns of various calibers. Machinery is expected from Germany by means of which 200,000 to 500,000 Mauser cartridges will be produced daily. Factories are also to be established shortly for the manufacture of side-arms. Ten Persian officers have been sent to Germany to be present at the experiments with new quick-firing Krupp guns, and two went to Havre to witness the firing of the Creusot guns.—*Army & Navy Journal*, July 20.

GARLAND AUTOMATIC 1-POUNDER.—Agents of the Russian government have been in treaty with Mr. Frank M. Garland, of New Haven, Conn., U. S. A., with regard to his invention of a quick-firing gun, especially designed for use in the fighting tops of war ships, which will fire 1 lb. projectiles at a rate of 208 per minute. The gun is said to be capable of keeping up this rate of fire, presumably with intervals, for 12 hours at a stretch, and if so, it is certainly a deadly weapon. Two Russian agents appear to have submitted it to searching tests, and to have reported favorably upon it, and they are now awaiting the confirmatory report of a third expert. Should his verdict agree with those already given, we understand that Russia will be prepared to purchase the entire plant, in which case it is probable that Mr. Garland will go to Russia to superintend the processes of manufacture.—*Arms & Explosives*.

ADAPTER FOR FIRING BLANK CARTRIDGES FROM AUTOMATIC MACHINE GUNS.—Mr. W. G. Hay, of Liverpool, England, has recently patented a device for firing blank cartridges for automatic machine guns whose mechanism is operated by the lateral escape of gas from the barrel. Applied to the muzzle is an adjustable stop by which the passage for issue of the combustion gases can be more or less throttled, so that they are for a time maintained at sufficient pressure to blow aside the lateral gas lever or operate the piston or plunger which works the lock mechanism. In order to render the blank cartridges suitable for being fed by the usual mechanism they may be elongated, but preferably there is put

in the mouth of each a hollow wooden plug of bullet shape. These plugs, it is stated, as they meet the stop at the muzzle, are burst into small pieces by the gas pressure within them. The stop for the muzzle is preferably in the form of a set screw lodged in a socket which can be screwed on the muzzle. Patent issued May 15, 1901.

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## GUNS: FIRING

**NOTE.—Under this head will be given notes referring to firing tests of guns, target practice, special practice, accidents to guns while firing, etc.**

TESTS AND DESCRIPTIONS OF U. S. NAVAL GUNS.—The following descriptions and tests of U. S. Naval guns, 3-inch, 4-inch, 6-inch, and 12-inch, are furnished by Lieutenant W. G. Turpin, U. S. N., recently assistant inspector of ordnance at Indian Head.

UNITED STATES NAVAL 12-INCH, 40-CALIBER GUN: TRIALS, AND REMARKS UPON GUN AND MOUNT.—This is the latest design of 12-inch guns, and is designed to give 2800 f. s. with a chamber pressure of 17 tons, using a suitable smokeless powder. The principal advance over the older guns is the increased initial velocity and consequent increased energy of the projectile. Two things produce these results, the increased length of the bore and the increased size of the powder chamber, the latter of which is most important.

The mount, like that of all recent guns, is of the spring-return type, having four recoil cylinders, each of which contains a set of springs to return the gun to battery. The gun proper is without trunnions and recoils in the line of fire in a sleeve which carries the trunnions, elevating gear, and recoil cylinders.

The breech mechanism is an adaptation of the Fletcher-Farcot mechanism to the Welin block. The stepped slotted screw, owing to greater portion of the circumference (three-fourths in this gun) bearing, permits a shorter block and reduces the time of opening, as the necessary angle of rotation and length of translation (retraction) are both less.

The gas check is of the De Bauge type with split rings instead of discs. The firing lock is of a new type (Mark VIII), in which the opening of the lock automatically ejects the old primer; it is designed to use the combination primer. The elevating gear is of usual type for these guns and can be operated either by hand or power.

The following are the ballistic results of firing one sample of smokeless powder, using the ordinary 850-pound projectile.

| Round. | Charge, pounds. | Pressure, tons. | Muzzle velocity, f. s. |
|---|---|---|---|
| 1 | 240 | 5.95 | 1913 |
| 2 | 280 | 9.35 | 2123 |
| 3 | 304 | 10.9 | 2344 |
| 4 | 328 | 13.0 | 2531 |
| 5 | 350 | 15.5 | 2770 |
| 6 | 360 | 16.5 | 2837 |
| 7 | 370 | 18.0 | 2885 |
| 8 | 376 | 20.5 | 2899 |

UNITED STATES NAVAL 6-INCH, 50-CALIBER GUN: TRIALS, AND REMARKS UPON GUN AND MOUNT.—This gun is similar to the 5-inch of the same length (see PROCEEDINGS No. 98, page 425). The breech mechanism is exactly the same. The piece is designed to give a velocity of 3000 f. s. with a pressure of 17 tons in the chamber. The velocity in service is fixed at 2900 f. s.

The mount is of the pedestal type, being somewhat modified from the earlier designs to withstand the increased energy of the gun. The latter is trunnionless, recoils in a sleeve and is returned to battery by springs. The recoil cylinders are two in number and are placed under the gun. The cartridge case has been discarded and the charge put up in a bag. The modified De Bauge type of gas check is used. The lock is arranged for electric or percussion firing and automatically ejects the old primer case when the breech is opened. In case of failure of the primer the gun can be cocked without opening the breech.

The elevating and training gears are of the usual type and are convenient to the gun firer, who stands on a platform revolving with the gun.

The following are some of the results of firing:

| Round. | Charge, lbs. | Pressure, tons. | Muzzle velocity, f. s. |
|---|---|---|---|
| 1 | 33 | 7.45 | 2141 |
| 2 | 36 | 8.9 | 2325 |
| 3 | 40 | 11.95 | 2577 |
| 4 | 44 | 14.5 | 2822 |
| 5 | 45 | 15.35 | 2848 |
| 6 | 46 | 16.15 | 2935 |
| 7 | 46.5 | 16.35 | 2955 |
| Tests of another sample: | | | |
| 1 | 30 | 7.8 | 2153 |
| 2 | 35 | 9.83 | 2365 |
| 3 | 40 | 12.4 | 2677 |
| 4 | 43 | 14.4 | 2821 |
| 5 | 44.5 | 15.3 | 2850 |
| 6 | 45 | 15.8 | 2932 |

UNITED STATES NAVAL 4-INCH, 50-CALIBER GUN: TRIALS, AND REMARKS UPON GUN AND MOUNT.—In this gun the brass cartridge case is retained and the projectile is made up in one with the powder. The powder is enlarged as in the other guns and this necessitates a bottle-shaped case. Like the other 50-caliber guns, this is designed for a velocity of 3000 f. s. with a chamber pressure of 17 tons, but the service velocity is fixed at 2900 f. s. The gun recoils in a sleeve and is returned to battery by springs in the two recoil cylinders, which are placed underneath the sleeve. The mount is of the pedestal type. The breech mechanism is the modified Fletcher-Farcot and operates a Welin breech plug, which has two blanks and four threads. The plug is carried in a collar, but does not have to be retracted before the breech is open, but is swung directly out as soon as unlocked. The extractor is carried on the front end of the block in a manner somewhat similar to that of the Dashiell. Electric or percussion firing can be used, the change being made by shifting a small catch. The primers in the cartridge cases are

all of the combination type. The following are some of the ballistic results obtained with this gun, using a 32-pound shell:

| Round. | Charge, lbs. | Pressure, tons. | Muzzle velocity, f. s. |
|---|---|---|---|
| 1 | 12 | 9.1 | 2200 |
| 2 | 14 | 12.8 | 2586 |
| 3 | 15 | 14.35 | 2761 |
| 4 | 15.5 | 15.9 | 2891 |
| 5 | 16 | 16.4 | 2943 |
| With another lot of powder: | | | |
| 1 | 10 | 4.65 | 1831 |
| 2 | 13 | 8.1 | 2343 |
| 3 | 15 | 12.1 | 2751 |
| 4 | 15.5 | 14.3 | 2899 |
| 5 | 16 | 17.4 | 3039 |
| With third lot of powder: | | | |
| 1 | 10 | 6.3 | 1893 |
| 2 | 12 | 8.7 | 2201 |
| 3 | 13 | 10.3 | 2363 |
| 4 | 15 | 13.3 | 2717 |
| 5 | 15.5 | 14.2 | 2805 |
| 6 | 16.1 | 15.15 | 2903 |
| With fourth lot of powder: | | | |
| 1 | 12 | 9.7 | 2315 |
| 2 | 14 | 13.0 | 2657 |
| 3 | 15 | 16.0 | 2922 |
| 4 | 15.5 | 16.3 | 2972 |
| 5 | 15.75 | 16.7 | 3003 |
| With fifth lot of powder: | | | |
| 1 | 14 | 13.0 | 2668 |
| 2 | 15.5 | 16.4 | 2982 |
| 3 | 15.75 | 18.2 | 3079 |
| With sixth lot of powder: | | | |
| 1 | 15 | 16.6 | 2931 |
| 2 | 15 | 16.3 | 2898 |
| 3 | 15.5 | 17.6 | 3046 |
| 4 | 16 | 19.0 | 3155 |
| 5 | 16.15 | 20.2 | 3204 |

All these results are good, except, perhaps, the first, which was a little too slow burning for the gun. The second and fifth samples gave excellent results as regards both pressure and velocity. The last sample showed a high ballistic efficiency per pound but the pressures were high.

UNITED STATES NAVAL 3-INCH, 50-CALIBER GUN: TRIALS, AND REMARKS UPON GUN AND MOUNT.—This gun, like the 4-inch, has a bottle-shaped brass cartridge case with the charge and projectile in one. Like all of the 50-caliber guns, it is designed to develop 3000 f. s. velocity with

17 tons pressure in the chamber. The service velocity is fixed at 2800 f. s. The gun recoils in a sleeve. The recoil cylinders, two in number, are placed under the gun and contain the liquid and counter-recoil springs. The breech mechanism differs somewhat from that of the larger guns as the step system is not used. The plug has no motion of translation to the rear, but is swung out as soon as unlocked. This is effected by cutting away in the arc of a circle the blanks of both plug and screw box, which are farthest from the hinge of the plug. This latter is not carried in a collar but its rear end is held in a plate which closes the breech, and is hinged like the usual plug collar. The later types have a catch to prevent the rebound of the plate when closing the breech. The plug is rotated by means of a small rack sliding in the breech plate, resembling that in the Dashiell mechanism. The firing mechanism is for percussion, and the lock can be cocked when the breech is closed. The case is not ejected entirely by the extractor; that is, it is not violently thrown out—it may be fully ejected if the gun is slightly elevated. The gun is trained and elevated by mechanism, as it was found to be too heavy for training and elevating with a shoulder piece. No rapidity tests were made, but it can be loaded and fired much more rapidly than is consistent with accurate firing. The endurance of these guns seems to be ample. Several have been fired a large number of times. One has been fired 376 times with high velocities and pressures—the latter ranging from 13 to 19 tons—and it shows no signs of wear or erosion. The following are some of the ballistic results attained with the service 13-pound projectile:

| Round. | Charge, lbs. | Pressure, tons. | Muzzle velocity, f. s. |
|---|---|---|---|
| 1 | 4 | 9.6 | 2337 |
| 2 | 4.5 | 13.0 | 2710 |
| 3 | 5 | 14.75 | 2841 |
| 4 | 5.1 | 15.4 | 2915 |
| 5 | 5.2 | 16.3 | 2942 |
| With another sample of powder: | | | |
| 1 | 4 | 8.7 | 2109 |
| 2 | 4.5 | 10.75 | 2331 |
| 3 | 4.75 | 11.9 | 2470 |
| 4 | 5 | 13.0 | 2590 |
| 5 | 5.2 | 13.65 | 2656 |
| 6 | 5.4 | 14.7 | 2778 |
| 7 | 5.6 | 16.55 | 2858 |
| With a third lot of powder: | | | |
| 1 | 4.75 | 11.9 | 2534 |
| 2 | 5 | 14.8 | 2796 |
| 3 | 5.1 | 14.8 | 2824 |
| 4 | 5.2 | 15.8 | 2870 |
| 5 | 5.3 | 16.5 | 2902 |

Of these samples the first was much the best.

UNITED STATES NAVAL 7-INCH GUN: TEST.—According to newspaper reports, this gun has, within a few days, had a very satisfactory test. With a projectile of 170 pounds (165?) the muzzle velocity was over 3000 feet, the chamber pressure being 17 tons. The designed service velocity is 2900 f. s.

MORTAR TRIALS AT PORTLAND.—"Most encouraging reports come to us of the results of the trial of mortars at Port Preble, especially with regard to the accuracy of fire. On one of the small islands in the harbor chosen as a target, it has marked a space equivalent to that of the length and width of a modern battleship. Within this space fell 25 per cent of the mortar shells fired at long range. Within a circle having the length of the battleship for its diameter one-half of the shots fell."—*Army & Navy Journal*, November 16.

BROWN 10-INCH WIREWOUND GUN: BREECH BLOWN OFF; DESCRIPTION OF GUN.—This gun, which was recently completed, gave way at the ninth round while under test at Sandy Hook Proving Ground October 28. The jacket yielded near the forward end of the screw box, its rear end containing the breech plug being driven to the rear with such force that it struck and wrecked a concrete structure, 200 feet in rear, on which lay several unmounted mortars. The shock of striking the concrete broke in two the ring of the jacket which had been broken off. [This is an excellent commentary on the character of the jacket metal.] The breech block and bushing surrounding it were practically uninjured. Mr. J. N. Brown and Mr. H. M. Munsell, trustees of the Brown gun, attribute the giving way of the jacket to the failure of the De Bauge gas check, whereby the whole forward surface of the plug and breech bushing was exposed to the powder presence. This is possible, but unlikely. A properly constructed De Bauge gas check, having suitable steel rings, acts better and obturates more perfectly with a high pressure than with a low one; one that fails must be very poorly constructed. And an ordinary failure to obturate perfectly would not allow the gas to escape fast enough to create a high pressure behind the gas check. The most likely cause of failure was that the cast-steel jacket was of insufficient strength. Cast steel is very uncertain in its behavior. Its power to resist very sudden stress is not to be measured by methods that are accurate enough with forged metal. The behavior of the ring of metal pulled off the jacket shows it must have been very brittle and of slight tenacity, or it ought not to have broken when it struck the concrete. For twenty years cast steel has been discarded as a gun metal, and it is hard to understand why the designers of the Brown gun should jeopardize their work by using it. It is by the incorporation of such ill-considered features that many otherwise good inventions have failed. While the compiler is opposed to all systems of wirewound guns in the present condition of gunpowder development as affording no *useful* addition to the transverse strength of the piece, while in all systems of wirewinding the longitudinal stiffness is seriously impaired. Now longitudinal stiffness is necessary to insure accuracy and reduce the amplitude of the lateral vibrations in the long guns of the present day.

So far as can be judged from theoretical considerations and the tests as far as shown, the Brown gun is probably as good as any wirewound piece. If the segments can be so closely fitted as to bring their full elastic strength into play, the discontinuity of the metal must tend to check vibration in the chase. But the close fitting of the segments must be a difficult matter, for the friction which is relied upon to enable them to exert their strength in a transverse direction must resist the squeezing effort of the wire to bring them into proper position.

The Brown gun has frequently been described, and the compiler in-

tended to furnish a section of the gun in the notes for this number of the PROCEEDINGS, but the drawing was accidentally omitted. It consists of a thin tube surrounded by a segmented body. Over this is wound several layers of wire. Over the wire a thin casing of steel covers the chase and a jacket, with its front end reaching over the rear end of the casing, extends far enough beyond the breech face of the tube to form a housing for a breech ring, or bushing, in which is formed the screw box. The segmental core for the 5-inch gun (and it is similar for the 10-inch) consists of eighteen sheets of steel 19 feet long, 24 inches wide at one end, 6 inches at the other, and one-seventh of an inch thick. The manner of combining them may best be illustrated as follows: Imagine sheets of elastic cardboard of these proportions (say one-twelfth of the dimensions given) laid in a pile so that the edge of each is set back slightly from the edge of the one beneath it. Hold the sheets so that they will not slide upon each other and roll them up into a slightly conical tube about half an inch in inside diameter. If the sheets were properly placed before rolling, the outer edges of the cardboard will show at equal distances around the circumference. Now smooth out the interior of the tube by smoothing down the edges of the cardboard until the interior is a perfect cylinder. In the actual gun the sheets are put together in this way but are shaped before being assembled. After the segments are in place, numerous clamps are put on to hold them together and the tube inserted by hydraulic pressure. The wire is then wound on with a tension of 2600 pounds, but as the cross-section is small this is equal to a stress of 128,000 pounds per square inch. The end of the wire is secured by means of a metal plug in a hole in the first shoulder of the muzzle ring, thence to the breech and back to the muzzle again. The second layer begins at the second shoulder and is similarly wound as are the remaining layers. The chase jacket is then forced on by hydraulic power and a threaded muzzle cap or ring screwed on. The jacket is then shrunk on, the lining tube bored and rifled, and the breech bushing fitted and slotted to receive the breech plug.

GATHMANN GUN TEST: FAILURE TO ACHIEVE RESULTS EXPECTED BY INVENTOR.—Strictly speaking, this was a projectile test; but as it involved the whole Gathmann system, including gun, powder, and projectile, it has been placed under the head of GUNS: FIRING. Only newspaper accounts of the test are as yet available. And many interesting points are not touched upon. The inventor claimed that the gun would develop a muzzle velocity of 2100 foot seconds with only 20,000 pounds maximum chamber pressure. This the compiler regarded as absurd. The newspaper accounts do not give the velocity attained but say that the muzzle energy was 40,000 foot tons. This would mean a muzzle velocity of about 1800 f. s., which is probably all the gun is capable of safely developing.

The target was a steel armor plate supported by the same sort of structure as is found behind it in ships. In rear of this, and bracing it to receive the blow, were heavy pieces of timber driven deeply into the earth, and in rear of this again a heavy sand butt. The plate was of Krupp face-hardened steel, made at the Carnegie armor factory, and its dimensions were: 16 feet by 7.5 feet by 11.5 inches. The weight of the Gathmann shell was 1860 pounds. Its probable striking velocity, a little less than 1800 f. s. In the first trial, November 15, the projectile struck

the plate near the center, dishing it about two inches at the point of impact but not otherwise injuring it or its supporting structure. On the 16th of November two more shots were fired at the target. The first struck in the right side of the plate about half way from the center to the edge. The only effect was to force the right edge of the plate backward a few inches. The other shot was directed at a similar point on the left side of the center. It buckled the framing behind the armor considerably and set back the left edge of the plate about 18 inches. Mr. Gathmann admitted that the results were not up to his expectations but thinks they warrant further experimentation, and that if it had been a battleship which was struck the shock of the explosion would have put her out of action. In this he is certainly mistaken. Not even the crushing of the plate into several pieces would necessarily put the ship out of action.

BRITISH 12-INCH GUNS: SPEED OF FIRING.—In the recent trials of the 12-inch guns on the new British battleship Formidable, ten rounds were fired from two guns in 4 minutes 46 seconds, and six rounds from two guns in 2 minutes 24 seconds. In all cases the start was with loaded guns.

BRITISH 9.2-INCH GUNS: SPEED OF FIRING.—At the recent trials of the 9.2-inch guns of the Aboukir, five shots were fired from one gun in 85 seconds. The weight of the projectile is 380 pounds and that of the cordite charge 52 pounds.

FATAL ACCIDENT WITH 6-INCH GUN ON THE ROYAL SOVEREIGN.—A terrible accident took place on board the British battleship Royal Sovereign on November 9, by which Captain Spurway, R. M. A., and five men were killed, one other man possibly fatally injured, and three officers and thirteen men less severely injured. The accident is reported to have been caused by the protrusion of the firing pin so far beyond the face plate that it struck the primer with sufficient force to fire it when the breech plug was forced home and before it was screwed into place.

BELLEISLE: PREPARATIONS FOR NEW TRIALS.—The old type battleship Belleisle has been refitted for further trials as a target. A plate of Krupp steel 4 inches thick and 20 feet long has been placed in one side and similar plate 6 inches thick on the other. The firing will be done by the gunboat Pincher, of 265 tons, which has had mounted on board a 9.2-inch gun and several smaller pieces. The trials are expected to be of long duration and the results will be carefully observed. After every shot the Belleisle will be visited and the effects carefully noted.

TARGET PRACTICE IINSTRUCTIONS, BRITISH NAVY.—"The following instructions have been issued by the Admiralty to the Commanding Officers of all British Naval Stations: 'All ships under your command that exceed 4000 tons displacement are to carry out target practice once a year under the following conditions:—A target, 50 ft. long by 25 ft. high, and having a mast 35 ft. high, is to be laid out. At this, each ship is to make two runs on a straight course, opening fire at 6000 yards from the target. One run is to be made for each broadside. The ship to steam at twelve knots, and firing is to be continued for four minutes

during each run. All heavy guns that will bear are to fire on each run, but not light quick-firing and machine guns. The firing basis is not to be marked by buoys, and the distances of the target are to be found and given to the guns by the methods which would be available in war time. One ship is to mark for the other, and only actual hits are to be counted. No ship is to carry out this exercise that has not completed a quarter's practice since commissioning. An annual report of the results obtained by these long distance practices is to be made to the Admiralty.' "—*Army and Navy Journal.*

BEST TARGET RECORDS IN BRITISH NAVY IN 1899, 1900, 1901.—The best scores in the British navy for the last three years are: 1899, Scylla, 46 per cent of hits with 6-inch gun, 80 per cent with 4.7-inch gun; 1900, Terrible, 60 per cent with 9.2-inch guns, 77 per cent with 6-inch guns; 1901, Terrible, 64 per cent with 9.2-inch guns, 80 per cent with 6-inch guns. Lieutenant M. Woollcombe, gunnery lieutenant of the Terrible, in his report on the recent prize firing, says: "The shooting and loading of the after 9.2-inch are worthy of notice; in six minutes this gun fired 12 rounds and hit the target 9 times, which is 1.5 hits per minute. This is more than the fleet average for 6-inch Q. F. guns."—London *Times.*

RECENT TARGET PRACTICE IN BRITISH NAVY.—"The much greater interest that is being displayed in the Navy in the matter of good shooting is bearing fruit and is one of the most gratifying signs of the times. Admirable records have been made by the Terrible and Barfleur in China, while in the Mediterranean Sir John Fisher's officers have accomplished excellent things. Thus the Isis made considerably over 30 per cent of ascertained hits with her 6-inch guns before going out to China and the other records of the ships were extremely good. Now it is reported from China that the Ocean, in firing 110 rounds from her 6-inch guns, has made an average of over 52 per cent. It is, of course, very desirable that such results should be carefully verified, and that the splash of the shell should not be counted as a hit. We do not for a moment suggest that this has been done, but where high records are made it is very desirable that they should be completely authoritative. It is certain that good practice is now being made at ranges never before dreamt of, at any rate for real fighting, and evidently, if even 10 per cent of hits can be made at 5000 yards and 5 per cent at 7000 yards, it would be worth while, in a chase, to open fire at the latter range, and very possibly at the opening of a regular engagement. Some slight doubt has been suggested as to 30 per cent of hits having been made at a target supposed to represent a cruiser at 5000 yards, but it is well ascertained that this percentage has been exceeded in the Mediterranean, and the fact that 80 per cent of hits has been obtained by the Terrible strongly disposes us to look for very high averages, and the 52 per cent of the Ocean, though highly gratifying, is not perhaps surprising. The Terrible's results were phenomenal, but the Prince George last year made a record of 55.9 per cent, while in 1899 the Scylla had 46 per cent of hits with 6-inch guns and 80 per cent with 4.7-inch guns. The progress made is most gratifying and is admirable testimony of the efforts made by the officers."—*Army and Navy Gazette*, London, September 7.

TARGET PRACTICE IN FRENCH NAVY: OLD TORPEDO BOAT AS TARGET.—"The French Mediterranean Squadron has been engaged in its quar-

terly target practice. At the conclusion of the exercise, the ships proceeded to a point at which the Toulon authorities had moored an old torpedo-boat, which was to serve as a target for shrapnel shell. The aiming practice is said to have been good in most of the ships. It was hoped that the torpedo boat, in which some special arrangements had been made, would not sink, and that it would be possible to discover the amount of damage done upon her, which would have been interesting, considering the smallness of the target and the range, which was between 2000 and 3000 metres. Unfortunately for this hope the torpedo boat went to the bottom. It is not known whether this was owing to the direct blow of a shell or to damage caused by the shrapnel bullets."—*Army & Navy Gazette*, London, September 7.

IMPROVED SPEED OF FIRING OF FRENCH 34-CENTIMETER GUN.—The 34-centimeter turret guns of the Valmy have recently been fitted with a new system of loading designed by M. Guye, chef d'escadron de l'artillerie coloniale. The former speed of fire was one shot in 4 or 5 minutes. With the new apparatus the speed is slightly more than one shot per minute. Starting with the guns loaded, five shots were fired in less than four minutes.

NEW AUSTRIAN FIELD GUNS.—"According to the *Pester Lloyd*, the trials of the new wrought-bronze field guns, which are to be introduced into the Austrian Army, have proved very satisfactory. During the tests, which were conducted under conditions closely approximating to those of actual service, the trial batteries developed only a few slight faults, which are now in process of being remedied with a view to further trials being made. At the same time, it is in contemplation to make tests of the Ehrhardt quick-firing gun, first independently, and subsequently side by side with batteries of the bronze guns. The final decision as to which model shall be adopted will be made after the artillery practice at Veszprim, in Hungary, which will take place in the Emperor's presence some time in September."—*Arms & Explosives*, August, 1901.

COMPETITIVE TRIALS OF FIELD GUNS AT SANDY HOOK.—"The trial of field guns now going on will probably continue at Sandy Hook until after January 1, when the guns will be sent to Fort Riley. The trials with these guns are likely to continue, therefore, well on towards next May. Two foreign guns are being experimented with besides the Lewis and the Ordnance guns. The total weight of these guns behind horses approximate 3950 pounds, and the weight of the shell loaded and fused 15 pounds. A muzzle velocity of 1700-1750 f. s. is required with a pressure not to exceed 33,000 pounds per square inch. The powder must be of a known and satisfactory composition. Ammunition is furnished at the expense of the Government. Minor defects, not causing material delay, may be corrected, but no change of construction is permitted. Special attention is given to the mechanism of the gun, and the carriage, with reference to simplicity, strength, certainty of action, ease with which cylinders can be filled, broken parts of the carriage replaced, the gun mounted, elevated, depressed, moved from one extreme to the other in azimuth with wheels level or with one wheel higher than the other. The location of sights for easy and quick laying, especially while loading, will be noted; the number of bearing surfaces, the facility of

cleaning and lubricating them, and the length of trail and weight on trail in limbering. The calculations by which the strength of various parts was determined will be verified.

There will be tests with defective ammunition, and the dust and rust tests. Ten rounds will be fired with excessive pressures, two each with 35,000, 38,000, 40,000, 42,000, and 44,000.

When metallic ammunition is used, ten rounds will be immersed in water for five minutes, and then allowed to stand twenty-four hours before firing. Additional rounds will be subjected to a humidity test at a temperature of 100 degrees F., and relative humidity of 95 degrees for thirty days and then fired. Each limber with chest completely filled will be mounted on a vibrating table and be subjected to the jarring thereon for forty-eight hours, to see if the serviceability has been affected. It will also be subjected to the moisture test. Limber chests will be exposed to the weather for two weeks, and then examined and part of the contents fired.

In testing the guns for accuracy 50 shots will be fired, if necessary, at a 2500-yard target from clay or loam platform. Each gun will be subjected to four tests for rapidity. 1. Rapidly unaimed shots from loam platform, 10 rounds, the trail having been set by one shot. 2. Rapidity with accuracy from clay platform, 10 shell and 10 shrapnel at 2500 yards, the trail having been seated and range secured by not exceeding two sighting shots. 3. Same from macadam road or rock platform. 4. Maintained rapidity; forty-five aimed shots from clay platform. During this test the target will be twice changed; the targets being so placed that the trails will have to be shifted. These tests for accuracy and rapidity will be made at Fort Riley. Fifteen rounds will be fired in the general tests from clay, loam, sand, rock, and macadam platforms, five each at extreme and zero elevations, and extreme depression, an equal number of shots being with the gun at extreme position right and left, and in mean position. In these tests the jump, departure from line of fire, and depth of trail and wheels will be noted. When necessary to move the trail the power and time required will be noted. In addition, twenty rounds will be fired with trail rigidly supported by an oak post set into the ground and braced to prevent yielding. Carriages having recoil on the ground will, in rapidity tests, be limited to 40 feet, and the ground will be broken up to assimilate actual conditions. These guns and carriages which have not failed in the above will be subjected to a practice march of 150 miles, following country roads as much as possible. Careful examination will be made of the equipment en route and at the end of the march. Such additional rounds will be fired over and above those mentioned as may be deemed necessary to establish any point arising, and such additional tests will be conducted as may for any reason seem necessary to the Board of Ordnance and Fortification."—*Army and Navy Journal*, November 16.

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## GUNS: MOUNTS

UNITED STATES NAVY: NEW 12-INCH MOUNT.—In his annual report, Admiral O'Neil, Chief of Ordnance, U. S. Navy, says: "Plans have been prepared for a new type of mount for the 12-inch, 40-caliber guns, in which there are but two recoil cylinders, located under the gun, the

counter-recoil springs being placed below the recoil cylinders and actuated by levers which are attached to the yoke on the breech of the gun by connecting rods. The arrangement proposed allows of a reduction in the diameter of the barbette armor and of a reduction in the size of the port opening, both very important features.

NEW TYPE SIGHTS.—There have been some patents brought out abroad for an improved type of gun sight, in which the line of sight remains fixed and the gun is moved independent of the sight. The value of this invention is that the gun-firer can keep his eye on the target at all times, and a sight-tender can change the range (and elevation of the gun) without disturbing him. Patents for sights of this kind have been taken out by Maxim-Vickers, Krupp, Armstrong, Grenfell, Dawson, Schneider-Canet, and others.

## INSTRUMENTS USED IN ACTION, ETC.

**NOTE.—Under this head will be given notes on searchlights, range finders, stadimeters, torpedo directors, etc.**

VERTICAL BASE RANGE FINDER.—In his annual report, Admiral O'Neil says: "A new type of vertical-base range finder for use in the tops of vessels is on trial and gives promise of being a useful instrument."

BARR AND STROUD RANGE FINDER: REMARKS.—"Fleet Engineer Rees, R. N., speaking at a James Watt dinner at Glasgow, with Professor Barr, of Barr and Stroud range finder fame, in the chair, attributed the excellent shooting of the Terrible recently, every shot on the target from some guns—to Professor Barr's invention.—*Engineer*, London, January 25, 1901.

KLEPTOSCOPE: REMARKS, DESCRIPTION.—This instrument, which is designed for use in submarine boats, is similar to the periscope used in the French submarines. It is said to possess several advantages over the periscope, as it will have a more extensive field of observation (60 degrees), will not deform the images of external objects, permits of magnifying the images, and is inconscpicuous, as the part above water consists merely of a tube 5 inches in diameter. The Kleptoscope is the invention of Messrs. Russo and Laurenti, Italian naval engineers, and is now under trial by the Italian naval authorities.

## SMALL ARMS

NEW MODEL U. S. ARMY RIFLE.—In his annual report the Chief of Ordnance says: "A sample rifle, embodying all the merits of the present service arm, has been made, with simpler machining cuts, fewer parts (therefore less expensive to make), and double-lugged bolt for use of a cartridge giving 2200 or more feet per second velocity, and it has been tested sufficiently to warrant the construction of a second and improved one on the same lines. This rifle will be equipped with the rod bayonet."

KRAG-JORGENSEN MAGAZINE: NEW MODEL.—The Krag-Jorgensen Company has brought out a model of the magazine in which there are

said to be some improvements, but the method of loading the magazine and its position remain unchanged.

KRAG MAGAZINE: CYLINDRICAL TYPE.—Mr. C. H. J. Krag (Norway) has recently taken out a British patent for a cylindrical magazine. From the sketches published it is hard to see why the piece does not break in two at the magazine, as there seems to be very little to hold it together at this point.

BRITISH SERVICE RIFLE: DEFECTS, ETC.—"A somewhat curious memorandum has been issued by the Commander-in-Chief. It appears that considerable trouble—which is a mild way of putting it—has been caused during the war, more particularly with regard to the Imperial Yeomanry and other volunteer troops, by the loss of breech-bolts from the Lee-Enfield rifle. Those who are well acquainted with the .303 Service arm are aware that it is by no means perfect, and stories have long been current as to the necessity for securing the breech mechanism from unpremeditated opening by the use of a boot-lace or other contrivance. This tendency, however, is common to practically all bolt-actions, especially when the rubbing surfaces become a little worn, and it does not necessarily affect either the safe handling or the general efficiency of the weapon when in use. But there is a grave difference between this mere shaking open of the breech and the absolute freeing of the bolt from its shoe. In the one case, there will probably be the loss of one cartridge, and some little confusion in bringing the rifle up for firing, caused by the necessity for putting the bolt into position; in the other case, the weapon is entirely useless. From the existence of a necessity to draw attention to this contingency, it is evident that the stop-spring and hook on the bolt head, which are supposed in the Lee-Enfield to prevent the complete retraction of the bolt, do not stand the test of ordinary Service conditions. They are, in fact, not sufficiently strong to do the work required of them. It is no sufficient remedy for this state of affairs that the memorandum in question draws attention to the existence of a safety stud which will lock the bolt in position, and further points out that for the future the cost of replacing lost breech-bolts will fall more or less directly on the men who handle the weapons. It is to be hoped that this detail, among many others, is receiving attention from the experts who are engaged on the not impossible task of improving still further our essentially patchwork Service small-arm."—*Arms & Explosives*, October, 1901.

NEW GERMAN RIFLE, MODEL '98; TESTS OF AUTOMATIC RIFLES.—"It will be remembered that we gave, a few months ago, an illustrated description of the new Mauser rifle, 98, which has been adopted for use in the German army, and we understand that the manufacture of this arm is being proceeded with in due course. The German military authorities, however, do not appear to regard this improved magazine rifle as representing finality, for we learn that they are now subjecting various types of automatic rifles to a series of exhaustive tests at Spandau. For the present, while several kinds are being experimented with, no definite decision has been made, so that the re-arming of the troops with the new Mauser will continue pending further developments."—*Arms & Explosives*, September, 1901.

In regard to the issue of Model '98, the *Revue du Cercle Militaire* says: "Up to the present the model '98 has only been issued to the navy, to the infantry regiments of the Chinese expeditionary force, and to the 'Corps de garde.' During the past year no other troops have received the new gun. According to the *Berliner Tageblatt*, they are going to begin the rearming of several corps with model '98. The quantity of arms manufactured during the year at the works at Spandau, Erfurt, and Dantzic, and also the Mauser Works at Oberndorf, is sufficient for the armament of five or six army corps. The first corps to receive the gun is the third corps, which will get them in November and December (1901)."

NEW SWISS MAGAZINE RIFLE UNDER TRIAL.—"The Swiss military authorities are said to be now engaged in testing a new type of magazine rifle, the mechanism of which, according to rumor, is to effect a revolution in the rifle-making of the future. This remarkable weapon is the invention of M. Fleury, an engineer living at Aesch, near Basle, who is said to have got hold of the key to the whole question of magazine rifles. Probably this is a somewhat cryptic method of stating that the rifle embodies new features of more or less practical value, but as the Swiss military authorities are still preserving the utmost secrecy with regard to M. Fleury's invention, it is difficult to gather quite the direction in which novelty is shown, or how far it goes towards revolutionizing the construction of magazine rifles generally."—*Arms & Explosives*, August, 1901.

NEW SWISS REVOLVER.—"Swiss military papers speak in high terms of the new revolver which has been adopted for the mounted troops of the Swiss Army and which is the invention of two Berlin engineers. The recoil on firing brings a fresh cartridge from the magazine into the barrel. The pistol weighs 800 grammes (1 lb. 13 ozs.), and its centre of gravity lies immediately over the hand of the firer. The magazine carries eight cartridges, and practised shots can fire 48 rounds in from 28 to 30 seconds. The calibre of the weapon is 7.65 millimetres (0.32 inches), and its range is given at 2000 yards."—*Army and Navy Journal*, June 29, 1901.

BANG STRAIGHT PULL RIFLE.—Mr. S. H. Bang (Denmark) has recently taken out a British patent for a straight pull magazine rifle. The turning of the breech bolt to unlock, its backward and forward movements, and its turning during closing are effected by the backward and forward working of a hand-operated sleeve, or cover, which catches around the breech bolt, and which slides upon guides running parallel to the bolt. British patent dated August 10, 1901.

HAMILTON AUTOMATIC PISTOL.—This is the invention of Count G. H. R. Hamilton (who is, notwithstanding his name, a Swedish subject). The special feature of the arm is the recoiling bolt, which is of curvilinear form and moves in a correspondingly curved guide in the butt of the pistol. Date of British patent, May 11, 1901.

FORTELKA AND LEITNER MAGAZINE PISTOL.—This arm is the invention of two Austrians, Messrs. F. Fortelka and W. Leitner, and the British patent is dated June 15, 1901. The mechanism is operated in a manner

which resembles that of operating a double action revolver. Starting with the pistol discharged the first part of the pull of the trigger revolves the bolt; then the bolt is retracted, the empty case expelled, a new cartridge (pushed upward by a spring) slips into place ahead of the bolt, the bolt moves forward, loads the fresh cartridge and fires it. To continue the operation, it is then necessary to release the trigger. After it has gone forward again, pulling upon it causes the operations described to be reproduced.

A CHINESE INFANTRY RIFLE OF MAMMOTH SIZE.—The following account is translated from the *Rivista di Artiglieria e Genio:* "On account of its curious character we reproduce from the *France Militaire* of August 12 the following data of a gun with which the infantry of the Celestial Empire is to be armed, and which is the heaviest and most inconvenient piece at present known.

"This arm which, according to the paper mentioned, would be adopted after the Chinese troubles were over, is made at the Shanghai arsenal and is nearly a copy of the German Mauser, Bodel 1888, but on a scale almost three times as large.

"The caliber is 15 millimeters (0.59 inches); the length without bayonet is 2.55 meters (8.36 feet); the weight is over 20 kilograms (44 pounds). In order to handle a piece so unusual in character, three soldiers are required instead of one—two to hold it on their right shoulders in a horizontal position and the third to fire it.

"The range is equal to that of a small cannon, being 4000 meters (4373 yards). The cylindro-ogival bullet is like an artillery projectile, is of steel, and weighs 100 grams (0.22 of a pound); the muzzle velocity reaches 700 meters (2297 feet)."

CHINESE ARSENALS.—"Mr. Gerow D. Brill, who was until recently in the employ of the Chinese Government, states the Chinese have arsenals and smokeless powder factories at Foochow, Hanyang, Nanking, Chengtu, and near Canton. At Hanyang there are factories working at full pressure, night and day, turning out hundreds of magazine rifles, and they have also all the machinery and metal for making large ordnance, quick-firing, and machine guns. There is also a factory there for the production of smokeless powder, and this is now in full work. The same informant expresses it as his opinion that Chang-chi-tung is one of the wisest men in the country, and that he is not making arms and ammunition for nothing, nor reorganizing the army without some definite object. He concludes an interview by saying, 'No one can tell what is going to happen in China.'"—*Army and Navy Journal*, October 5.

SMALL ARM FACTORY AT CALCUTTA.—"It is practically certain, says a *Times* telegram, that a rifle factory will be established on the good site available for a gunpowder factory at Ishapur, near Calcutta. The establishment of such a factory, capable of producing 25,000 rifles annually, would greatly increase the defensive strength of India, particularly as the work of the cordite factory in the Nilgeris is proceeding rapidly. India, in a few years, will be self-supporting as regards all war material except guns for artillery purposes. The manufacture of steel shells has proved a complete success."—*Engineer* (London), June 28.

PENETRATION OF BULLETS IN SAND.—In his annual report, the Chief of Ordnance, U. S. Army, says: "Tests show that the penetration of rifle bullets into sand and loam at 50 feet does not exceed 6 inches; at 500 yards, 13.5 inches; and at 1000 yards, 16.5 inches. At the short range of 50 feet the velocity is so high that before the displacement of the sand by the bullet the latter is completely destroyed; the lead is fuzed and the steel casing torn into ribbons."

PENETRATION OF SOFT-NOSED BULLETS IN FLESH, BONE, ETC.—The following letter appears in the *Army and Navy Journal* of November 2, 1901:

Some experiments I made at Matanzas, not long ago, with the valuable assistance of Dr. Lusk, veterinary surgeon, 2d Cav., convince me that the destructive effects of the soft-nosed or mushrooming bullet are generally exaggerated.

I used a Mauser pistol, and, as I wished to determine the stopping effect in a melee, I took a range of about six feet.

The steel jacketed bullet passed through from four to six 2x4-inch pine scantlings, while a bullet with half jacket and a square-shouldered soft nose, mushroomed and stopped in the second scantling regularly, and sometimes in the first.

Photographs of the track of this bullet through flesh showed mushrooming, and indicated that it would deliver the full effect of its blow instead of passing through, with, perhaps, little loss of energy, as in the case of the full steel-jacketed projectile.

I tested this on a condemned horse, which was shot through the brain and then immediately experimented on, while the flesh was warm and practically living. Shots were fired so as to pass through the full thickness of both hams from side to side, piercing the skin four times; the bullets, passing on, were not recovered. The channels of the two bullets were then immediately laid open side by side, and no difference in the track of the jacketed and the soft-nosed bullet could be noted; nor was there any difference in the size of the final wounds of exit. It is presumed that the photographs showed the result of experiment on cold, stiffened flesh, and that resistance offered in that case was sufficiently great to set up the bullet.

In a recent publication, the track of bullets through plastic clay has been offered as evidence of mushrooming effect; this will, I believe, also prove unreliable.

Firing at the canon bone the effect of the two bullets was the same—the bone was shattered, and literally pulverized. I was unable to get perforations of the leg bones without breakage with either bullet at this close range; the effect on knee and hock joints was shattering.

In passing through the skull from side to side the wound of exit of the soft-nosed bullets was double the size of that of the jacketed bullet, in this case the soft bullet having mushroomed on entering the skull.

In general no greater destructive effect was obtained by the use of the soft nose except where the bullet struck a bone and then passed on in the body.

FREDK. S. FOLTZ,
Captain 2d Cavalry.

Havana, Cuba, Oct. 16, 1901.

## TORPEDOES

TORPEDOES FOR U. S. NAVY: REPORT OF CHIEF OF BUREAU OF ORDNANCE.—The following is derived from the annual report of the Chief of Bureau of Ordnance, U. S. Navy:

"The use of torpedoes on large vessels has practically been discontinued, no provision having been made for them in the latest battleships and cruisers, and the torpedo armaments of the Olympia and San Francisco have been removed.

"Twenty-nine Whitehead torpedoes, Mark II, 5 meter, 45 centimeter, have been manufactured, and have successfully passed the required tests. One torpedo of this lot has been fitted with a device for superheating the compressed air, which upon experiment has been found to be of value.

"Two new gyroscopic steering gears for use in torpedoes have been tested. One has given good results. A feature of this new device is that it can be so adjusted that after the torpedo has been launched the torpedo will turn in the water through a predetermined horizontal angle, and then take up a straight course. Further experiments are in progress. A Kaselowsky steering gear, adapted to a Whitehead torpedo is in process of construction, and will soon be ready for trial.

"Six submerged tubes, of the Elswick-Whitworth type, for the Maine, Missouri, and Ohio, are in process of construction at the naval gun factory.

"An electrically driven air compressor has been completed and tested. Its dimensions are 75 by 56 by 34 inches over all. Its weight is 5000 pounds, the motor weighing over 3000 pounds, the machine and base weighing something less than 2000 pounds. The motor is shunt wound, makes 300 revolutions per minute, and develops 25 horsepower with an 80-volt current.

"There was installed on the Morris, at the torpedo station, an experimental torpedo electric firing apparatus. After tests with this, it is now being installed on all torpedo boats and torpedo-boat destroyers.

"This apparatus has a keyboard which can be manipulated by the commanding officer while he is conning the vessel. From this keyboard he can ascertain when the torpedo tubes are loaded and primed. By means of it he can fire at will any torpedo or all torpedoes at once from his position at the conn.

"The device, used in connection with the adjustable gyroscopic steering gear previously referred to, will enable the torpedo vessel to fire all its tubes simultaneously at one target, for after entering the water the torpedoes will all pursue a predetermined course in the direction of the target, as arranged for by the adjustment of the gyroscopic steering gear and the train of the torpedo launching tube."

ABOVE-WATER TUBES IN BRITISH NAVY.—"After an experience extending over fifteen years, the Admiralty have decided that, with the exception of the stern tube, all above-water torpedo tubes in battleships and cruisers are useless, and the earliest opportunity is to be taken of removing them. As this decision affects every ship in the Channel squadron, the annual refit of those ships will take considerably longer this year than usual."—*Engineer*, London, October 25.

LEAVITT AIR-HEATING APPARATUS FOR TORPEDOES.—Mr. F. McD. Leavitt, of Brooklyn, has taken out patents for heating the compressed air used in Whitehead torpedoes. In order to prevent refrigeration troubles, and to increase the efficiency of the air charge in Whitehead torpedoes, the air is heated near its point of exit from the flask by the burning of a supply of alcohol, whose flow is held in check and controlled by the pressure of air existing in the flask. The compressed air is free to enter an air space in the spirit receptacle, so that when the torpedo is set in motion the reduction of air pressure in the flask allows the pressure of the air in the spirit receptacle to preponderate and so force the spirit through an open tube into a vessel near the air passage, where it burns after being kindled by a fuse ignited on the release of the torpedo. The British patent is dated April 24, 1901.

ORLING-ARMSTRONG TORPEDO "ACTINAUT."—This torpedo is operated by wireless currents. It differs from the Varicas torpedo (PROCEEDINGS No. 97, page 207) in some respects, but the general principle involved is apparently the same. No good description of the details of the torpedo have yet appeared. It has been under development for several years, and about two years ago it was reported to have had successful trials before the king of Sweden. The following note appeared in the *Army and Navy Journal* of November 16:

"Experiments with the Orling-Armstrong system for the transmission of power without wires have been witnessed at Hughden by the Naval attachés of Germany, Austria and the United States. To this torpedo, which is steered by invisible radiation, the name of 'Actinaut' has been given. Captain Coerber, of the Imperial German Navy, was chosen by his colleagues to manipulate the apparatus at a distance of 1300 yards from the torpedo, while Captain von Schwartz and Commander Clover, of the Austrian and American Services, approached the trench in which the actinaut floated, in order to observe the movements of the rudder to port or starboard, according to the operator's will. It could, however, be held in three positions only—hard aport, hard astarboard, and amidships. The inventors claim that a simple mechanical contrivance will enable the rudder to remain five, ten, or fifteen degrees to port or starboard, as the movements of the target may require. An electric lamp enables the operator to keep the torpedo in view at night, while a contrivance for expelling a jet of water into the air, on the principle of a whale's blowhole, marks the position of the 'actinaut' by day."

DE LUCA—WHITEHEAD TORPEDO TUBES.—A new model torpedo tube, to which this name is applied, was tried on board the torpedo schoolship Trinacria at Spezia, Italy, on August 9, 19, and 20. The *Italia Militare e Marina* says that the trials were very successful and that vessels of the Italian navy will hereafter be fitted with tubes on this system.

# BOOK REVIEWS.

*Smokeless Powder, Nitrocellulose, and Theory of the Cellulose Molecule.* By JOHN B. BERNADOU, Lieutenant, U. S. Navy. New York: John Wiley & Sons; London: Chapman & Hall, Limited.

This book is the most important recent contribution to our knowledge of smokeless powders of the nitrocellulose type and of nitrocellulose in general. All ordnance matters are progressing so rapidly that it is with difficulty that the most studious officer can keep up with all new developments, and in no branch of ordnance is the difficulty more pronounced as in that of explosives. Much is being published on the subject; but a great deal of it is made up by the papers of inventors, written for the purpose of exploiting their wares; some appears in disconnected fragments in government and scientific societies' reports; and some in the general literature of chemistry. But there is no very late work in which this information is gathered and treated from the ordnance standpoint. It is therefore with the greatest satisfaction and interest that we receive Lieutenant Bernadou's work. He has not, of course, covered all the ground desirable, for we need a great deal of information from the proving ground and the testing laboratory. But he has taken up one branch of the subject—the chemical—and treated it in a most satisfactory manner. As to the author's views in regard to the structure of the cellulose molecule, the reviewer is not a competent judge. Only a few chemists, experts in this particular line of investigation, could pass upon the question. There are some facts in apparent opposition to the theory advanced, but it is quite possible that they can be shown to be in agreement. The author's discoveries that nitrocellulose dissolves in ethyl ether alone under the influence of intense cold, and that at similar temperatures all celluloses, with the apparent exception of the highly nitrated insoluble variety, dissolve in ethyl alcohol, are most important, as one of the troubles connected with the manufacture of stable, non-friable nitrocellulose gunpowder is the difficulty of drying the colloid containing a considerable percentage of water and alcohol without rendering the grains so brittle that they are liable to break up in the gun and so cause irregular—and perhaps dangerous—pressures. Such discoveries as these lead us to believe that in developing a purely nitrocellulose powder we are following the right path, and to hope that we shall in time produce a nearly ideal propellant.

The appendices, which form something more than half the book, are not less valuable than the main text. Their distinguished authors are so widely known that a review is needless to convey a knowledge of their importance, and the title in each case is a sufficient indication of the contents. The first is a tranlation by Lieutenant Bernadou of M. Vielle's "Researches upon the Nitration of Cotton"; the second is Lieutenant Bernadou's translation from the Russian of Professor D. Mendéléef's

paper on "Pyrocollodion Smokeless Powder": the third, a tranlation of a paper by M. Bruley on the "Nitration of Cotton"; while the fourth is a lecture delivered by Lieutenant Bernadou before the Naval War College in 1897.

L. S. V. D.

*Bulletin de L'Association Technique Maritime*, 1900.

This very valuable publication contains a mass of matter too extensive and diverse in character to be properly reviewed in a limited space, and only a few words can be said on the papers read before the Association. The first is one by M. Bertin, Director of Naval Construction, on the Stability of a Steamer after Collision (and injury). The other papers are:

*a*. Note on an Application of the Theory of Stability at small Angles of Inclination; by M. Van Meerten. This is very brief.

*b*. Note on a new Calculating Machine; by M. Bonnet.

*c*. Resistance of Ships; Effect of a Change in any Dimension; by M. Rota (Italian Navy).

*d*. Practical Formulas; by M. Afanassief.

*e*. Contribution to the Theory of the Screw Propeller; by M. Rateau.

*f*. Screw Propellers; by M. Stephane Drzewiecki. This is a very extensive paper on a subject of which we know entirely too little.

*g*. On a Rational System of Units in questions of Naval Construction; by M. Hauser (Chief Constructor, retired).

*h*. Standardizing of Results of Calculations; by Prof. Biles of Glasgow University.

*i*. The Future Fusions: Armored Cruisers, cruiser-destroyers, and Submarine Boats; by Colonel Cuniberti (Chief Constructor, Italian Navy). These are the three types towards which Colonel Cuniberti thinks all naval construction is tending. This is a very interesting paper, but we cannot quite accept all the distinguished author's conclusions.

*j*. The Fighting Ship of the Future; by Mr. F. C. Goodall, M. I. N. A., and A. C. Holzapfel. These gentlemen propose a ship 600 feet long, 100 feet beam, 28 feet draft, displacement 31,000 tons. This ship could be very perfectly protected and very powerfully armed.

*k*. Note on Tonnage Laws; by Mr. Isakson (Lloyds Inspector).

*l*. Tests of a Belleville Boiler; by M. Dugé de Bernonville.

*m*. Study of Boilers; by M. Montupet. This is a study of the Montupet Boiler, and is profusely illustrated.

*n*. Comparative Measures of Vibration on the German Cruisers Hansa and Vineta; by Herr G. Berling (Constructor, German Navy).

*o*. Vibrations of Steamers; by Herr Otto Schlick.

*p*. Propulsion of Ships by Discs, etc.; by Captain Garin (Spanish Navy).

*q*. Fatigue of Boiler Tubes; by M. Simonot. This is a long paper containing some data and an extensive theoretical investigation of the subject.

*r*. Note on the subject of a River Boat with Multiple Screws; by M. Ch. Doyère (Chief Constructor).

*s*. Protection of Hulls of Ships against the Torpedo and the Ram, and the possible Change of Form and Proportions to Assure this Protection; by M. E. E. Goulaieff (Russian Navy).

*t.* Memoirs on a New Type of Ship that does not Pitch or Roll and is Uncapsizable and Insubmergible; by M. Turc (Lieutenant, French Navy).

*u.* Construction of Petroleum Vapor Vessels in Sweden; by M. Hugo G. Hammar (Constructor, Swedish Navy).

*v.* Light Ships and Inspection Steamers of the United States Light House Service; by Mr. W. T. Sylven.

*w.* Electric Plant in the Lisbon Arsenal and on the Cruiser Rainha Donna Amelia; by M. Croneau (Chief Constructor, Portuguese Navy).

*x.* Notes on Refloating of Ships; by Mr. D. W. Noakes.

*y.* The Floating Dock as a Naval Auxiliary; by Mr. Lionel Clark, M. I. N. A. This paper contains several points of great interest.

*z.* Steel Hawsers for Towing and Gear for Operating Them; by M. Moissenet (Chief Engineer, French Navy).

*aa.* Water Screens; by M. Dibos. The water screen consists of a series of jets of water which can be interposed between a fireman and the steam rushing from a bursted tube or other fitting from which steam is escaping.

*bb.* Naval Architecture Considered from a Business Point of View and from that of its Effect on Commerce; by Mr. T. V. S. Angier.

*cc.* Description of the Works of the Newport News Shipbuilding and Dry Dock Company; by Mr. M. S. Chace.

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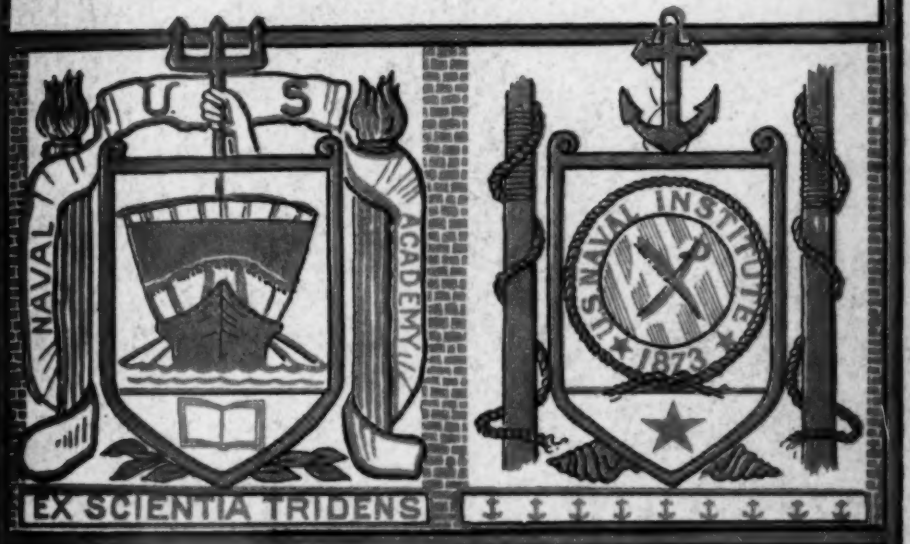


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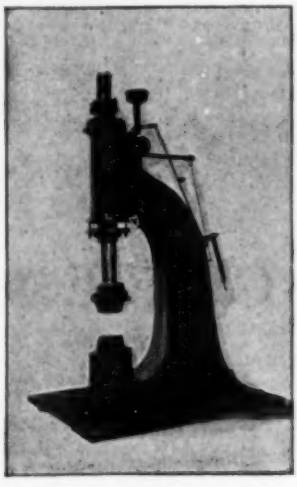

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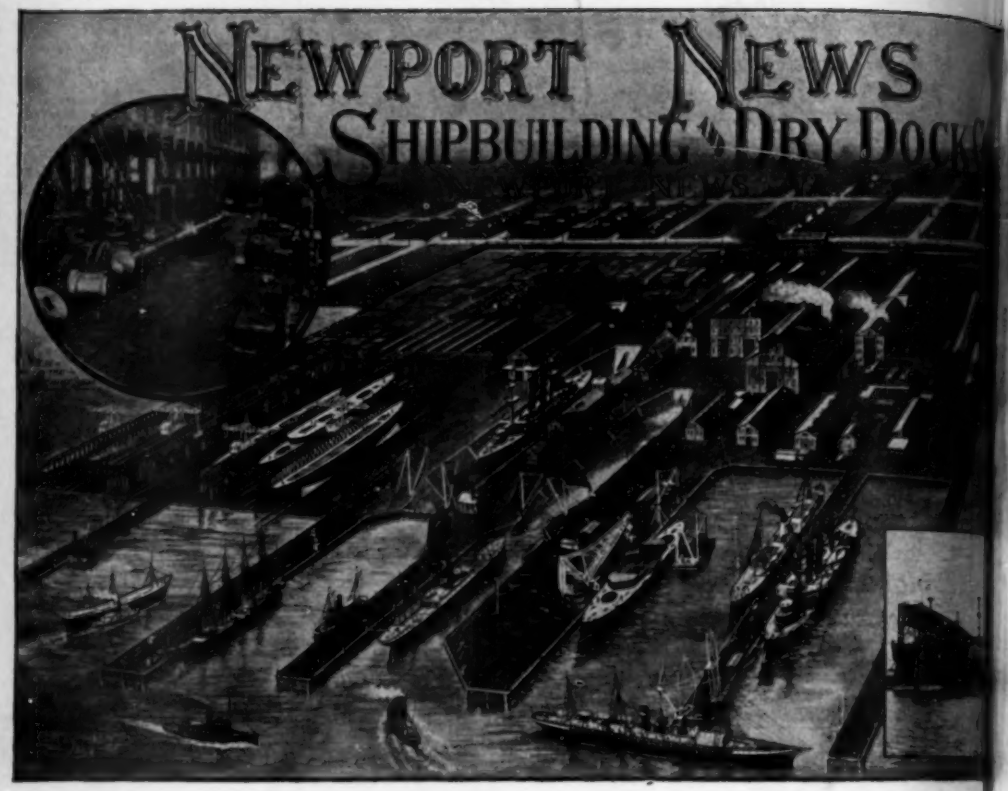


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| No. 1 | 60x900 Ft. | No. 4 | 80x550 Ft. |
| " 2 | 60x850 " | " 5 | 60x750 " |
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| | |
|---|---|
| Machine Shop, Brick | 100x500 Ft. |
| Boiler Shop, " | 100x300 " |
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| Ship Shed, " | 60x330 " |
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On the subject of membership the Constitution reads as follows:

### ARTICLE VII.

Sec. 1. The Institute shall consist of regular, life, honorary and associate members.

Sec. 2. Officers of the Navy, Marine Corps, and all civil officers attached to the Naval Service, shall be entitled to become regular or life members, without ballot, on payment of dues or fee to the Secretary and Treasurer, or to the Corresponding Secretary of a Branch. Members who resign from the Navy subsequent to joining the Institute will be regarded as belonging to the class described in this Section.

Sec. 3. The Prize Essayist of each year shall be a life member without payment of fee.

Sec. 4. Honorary members shall be selected from distinguished Naval and Military Officers, and from eminent men of learning in civil life. The Secretary of the Navy shall be, *ex officio*, an honorary member. Their number shall not exceed thirty (30). Nominations for honorary members must be favorably reported by the Board of Control, and a vote equal to one-half the number of regular and life members, given by proxy or presence, shall be cast, a majority electing.

Sec. 5. Associate members shall be elected from officers of the Army, Revenue Marine, foreign officers of the Naval and Military professions, and from persons in civil life who may be interested in the purposes of the Institute.

Sec. 6. Those entitled to become associate members may be elected life members, provided that the number not officially connected with the Navy and Marine Corps shall not at any time exceed one hundred (100).

Sec. 7. Associate members and life members, other than those entitled to regular membership, shall be elected as follows: " Nominations shall be made in writing to the Secretary and Treasurer, with the name of the member making them, and such nominations shall be submitted to the Board of Control, and, if their report be favorable, the Secretary and Treasurer shall make known the result at the next meeting of the Institute, and a vote shall then be taken, a majority of votes cast by members present electing.

The Proceedings are published quarterly, and may be obtained by non-members upon application to the Secretary and Treasurer at Annapolis, Md. Inventors of articles connected with the naval profession will be afforded an opportunity of exhibiting and explaining their inventions. A description of such inventions as may be deemed by the Board of Control of use to the service will be published in the Proceedings.

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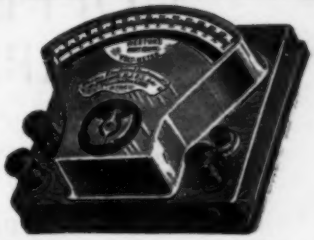

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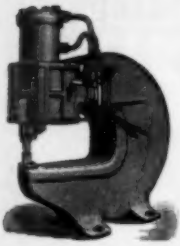

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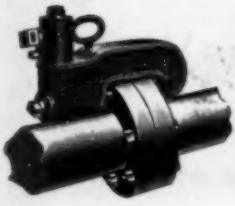

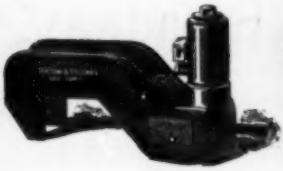

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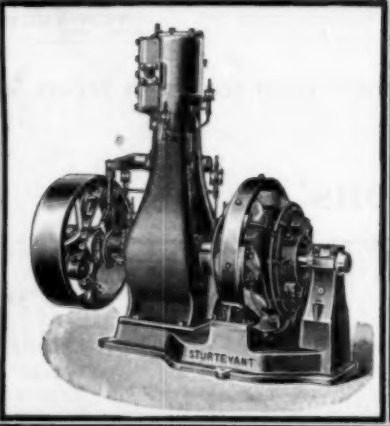


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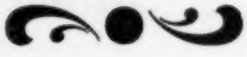

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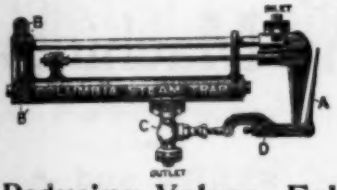


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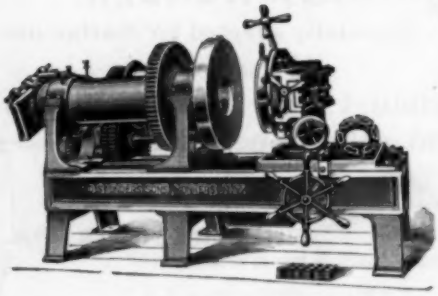

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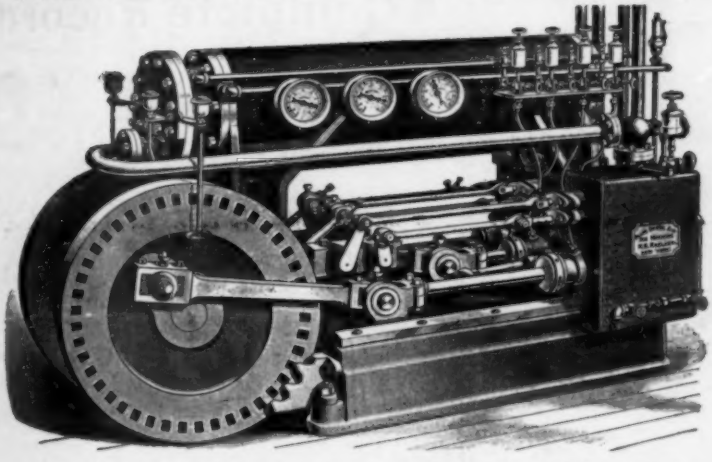

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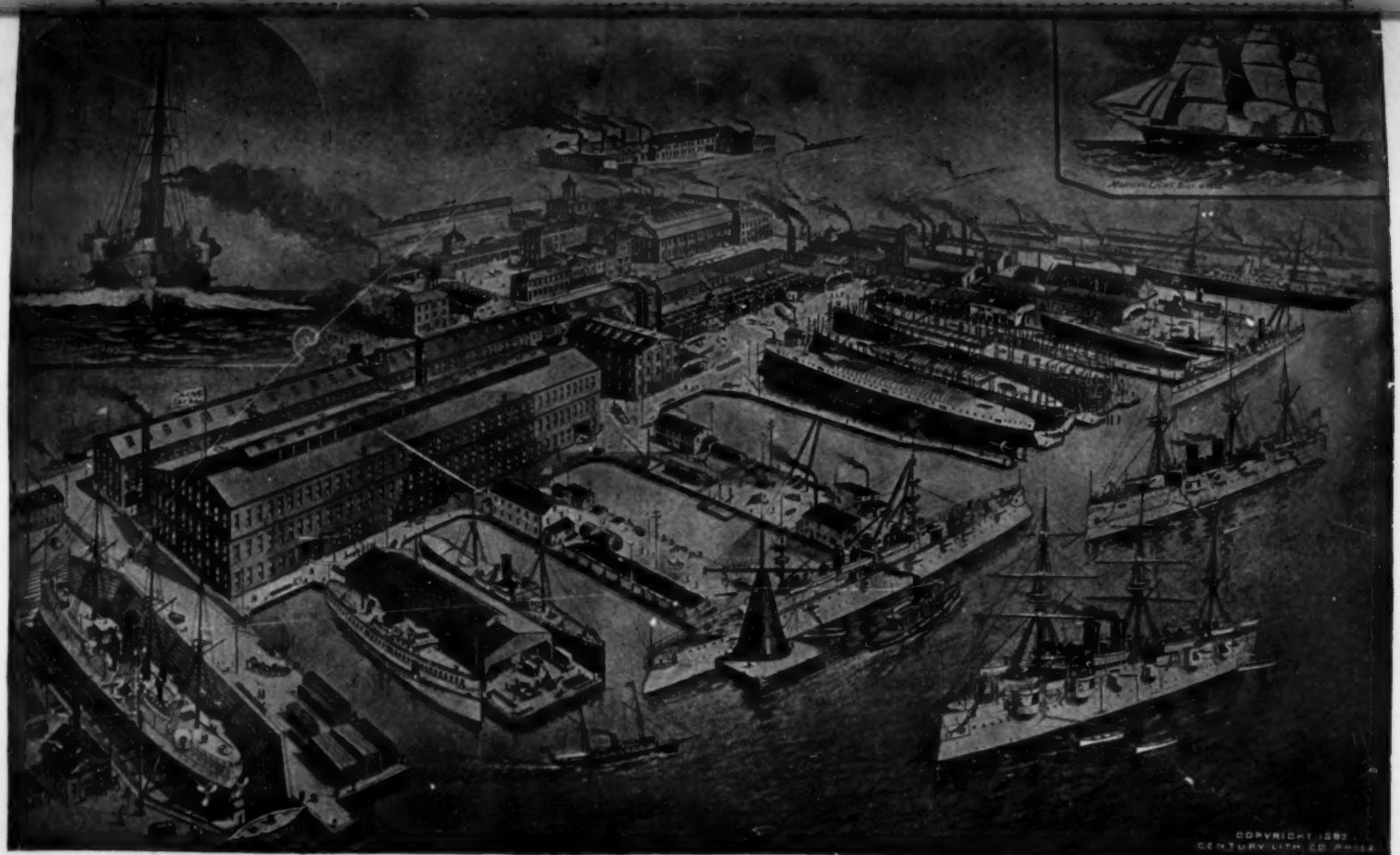


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